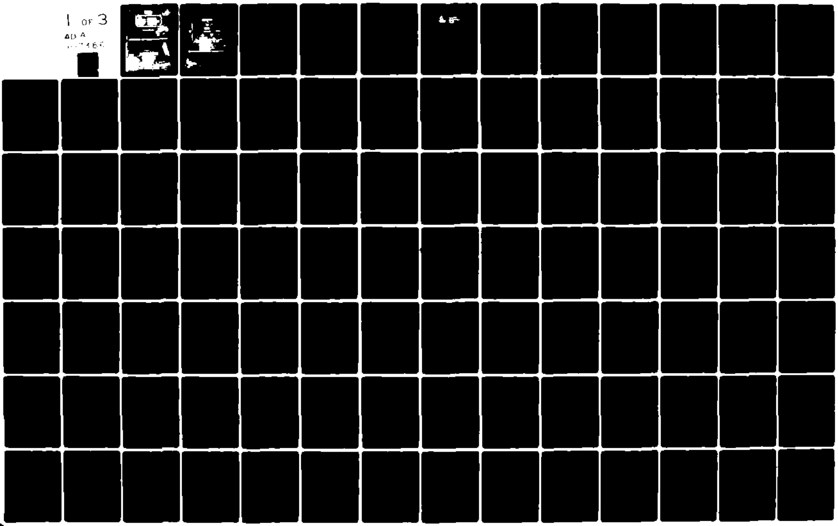
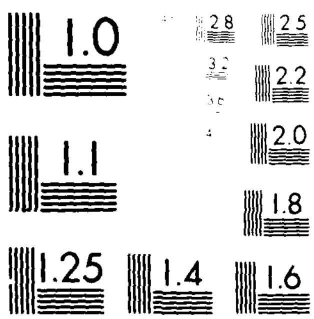
AD-A107 366   KEARNEY (A T) INC CHICAGO ILL   F/G 15/5
NATIONAL WATERWAYS STUDY OVERVIEW OF THE TRANSPORTATION INDUSTR--ETC(U)
AUG 81 V CHURCHWARD, E ISELY   DACW72-79-C-0003
UNCLASSIFIED   NL

1 OF 3
AD A
107366





MICROCOPY RESOLUTION TEST CHART

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A107366	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) (6) NATIONAL WATERWAYS STUDY Overview of the Transportation Industry.		5. TYPE OF REPORT & PERIOD COVERED (9) Final Report, Jan[redacted]79-[redacted]81
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Victor Churchward Edwin Isely A.T. Kearney, Inc.		8. CONTRACT OR GRANT NUMBER(s) (15) DACW 72-79-C-0003
9. PERFORMING ORGANIZATION NAME AND ADDRESS A. T. Kearney, Inc. 222 So. Riverside Plaza Chicago, IL 60606		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (11) Aug 81
11. CONTROLLING OFFICE NAME AND ADDRESS Institute for Water Resources/Corps of Engineers Kingman Building, Telegraph and Leaf Roads Ft. Belvoir, VA 22060		12. REPORT DATE July 1981
		13. NUMBER OF PAGES 248
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) (12) 251		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DTIC ELECTE NOV 1 0 1981 S H

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

transportation systems, water carriers, rail carriers, motor carriers, pipe lines, inland ports and terminals, seacoast and Great Lakes ports

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This NWS report, *Overview of the Transportation Industry*, is a review of the transportation carriers and ports and terminal industries. A profile of the transportation industry is presented, in addition to a review of the outlook, problems and impacts that other surface modes are likely to have on the waterways industry. This report focuses on specific issues of the waterway transportation industry as well as key issues related to rail, truck, and pipeline transportation. The primary purposes of this report are to (1) provide the transportation perspective to issues and factors which affect the commodity flow analysis; (2) provide a current understanding of transportation operations and equipment utilization; and (3) provide insight and understanding of transportation issues for the scenario development and evaluation of alternative strategies for managing the waterway system.

DD FORM 1473 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified 390410

THIS REPORT IS PART OF THE NATIONAL WATERWAYS STUDY AUTHORIZED BY CONGRESS IN SECTION 158 OF THE WATER RESOURCES DEVELOPMENT ACT OF 1976 (PUBLIC LAW 94-587). THE STUDY WAS CONDUCTED BY THE US ARMY ENGINEER INSTITUTE FOR WATER RESOURCES FOR THE CHIEF OF ENGINEERS ACTING FOR THE SECRETARY OF THE ARMY.

NATIONAL WATERWAYS STUDY

OVERVIEW OF THE TRANSPORTATION INDUSTRY

PREFACE

This report is one of eleven technical reports provided to the Corps of Engineers in support of the National Waterways Study by A. T. Kearney, Inc. and its subcontractors. This set of reports contains all significant findings and conclusions from the contractor effort over more than two years.

A. T. Kearney, Inc. (Management Consultants) was the prime contractor to the Institute for Water Resources of the United States Army Corps of Engineers for the National Waterways Study. Kearney was supported by two subcontractors: Data Resources, Inc. (economics and forecasting) and Louis Berger & Associates (waterway and environmental engineering).

The purpose of the contractor effort has been to professionally and evenhandedly analyze potential alternative strategies for the management of the nation's waterways through the year 2000. The purpose of the National Waterways Study is to provide the basis for policy recommendations by the Secretary of the Army and for the formulation of national waterways policy by Congress.

This report forms part of the base of technical research conducted for this study. The focus of this report, Overview of the Transportation Industry, is to provide a review of the transportation carriers and ports and terminal industries. The results of this analysis were reviewed at public meetings held throughout the country. Comments and suggestions from the public were incorporated.

This is deliverable under Contract DACW 72-79-C-0003. It represents the output to satisfy the requirements for the deliverable in the Statement of Work. This report constitutes the single requirement of this Project Element, completed by A. T. Kearney, Inc. and its primary subcontractors, Data Resources, Inc. and Louis Berger and Associates, Inc. The primary technical work on this report was the responsibility of A. T. Kearney, Inc. This document supercedes all deliverable working papers. This report is the sole official deliverable available for use under this Project Element.

FINAL REPORT

OVERVIEW OF THE TRANSPORTATION INDUSTRY

UNITED STATES CORPS OF ENGINEERS

OVERVIEW OF THE TRANSPORTATION INDUSTRY

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd.)

TABLE OF CONTENTS (Cont'd.)

LIST OF TABLES

LIST OF TABLES (Cont'd.)

LIST OF TABLES (Cont'd.)

LIST OF FIGURES

LIST OF EXHIBITS

I - INTRODUCTION

The focus of this report is a review of the transportation carriers and ports and terminal industries. The purpose of this report is to provide a profile of the transportation industry and to review the outlook, problems, and impacts that other surface modes are likely to have on the waterways industry.

This report focuses on specific issues of the waterway transportation industry as well as key issues related to rail, truck, and pipeline transportation. The primary purposes of this report are to (1) provide the transportation perspective to issues and factors which affect the commodity flow analysis; (2) provide a current understanding of transportation operations and equipment utilization; and (3) provide insight and understanding of transportation issues for the scenario development and evaluation of alternative strategies for managing the waterway system.

The scope of this report is limited to a series of field interviews and a review of the existing published literature and data.

Interviews were conducted with 17 water carriers, 26 shippers, 14 coastal port authorities, four railroads and 10 trade associations. The list of carriers contacted is presented in Appendix C of the Commercial Water Transportation Users report. Carriers representing inland, Great Lakes, and coastal operations were contacted after discussions with appropriate trade associations. Carriers were asked about such topics as type of traffic; type of equipment; day-to-day operating problems including repair and maintenance; potential conflicts with other uses of the waterways; safety problems; environmental conflicts; hazardous material transport problems; pricing strategy; rail competition; capital investment plans; and potential constraints to the growth of their operations.

Since this information is in some cases proprietary, carriers were assured that their comments would be kept

confidential. In no circumstances were any comments to be attributed to an individual company nor were company shipment data to be published in lieu of publicly available data on industrial production and shipments.

The list of shippers contacted is presented in Appendix B of the Commercial Water Transportation Users report. The primary purpose of these interviews was for the report on users, but, since many of these users also operate sizeable private fleets, every effort was made to incorporate their views as carriers in this report.

The list of coastal port authorities contacted is presented in Appendix D of the Commercial Water Transportation Users report. As in the case of carriers, coastal port authorities were asked to identify present problems and potential constraints to the future growth of their ports. The discussion in Section VIII of this report on "Concerns and Constraints to Port Operations" is a direct outgrowth of these interviews.

Aside from these interviews, no original research was conducted for this report. The existing studies and published data used for this report are presented in the bibliography at the end of this report.

It should be emphasized that the views of carriers did not represent the views of the contractor team or the Corps of Engineers.

The report is organized into the following sections:

- II - Description of Transportation Systems
- III - Review of Water Carriers
- IV - Review of Rail Carriers
- V - Pipelines
- VI - Motor Carriers
- VII - Inland Ports and Terminals
- VIII - Seacoast and Great Lake Ports
- IX - Conclusions
- Glossary
- Bibliography

II - DESCRIPTION OF TRANSPORTATION SYSTEMS

CHARACTERISTICS OF TRANSPORTATION

In order to better understand the discussions of the transportation industries which constitute the bulk of this report, it is useful to identify and understand certain key characteristics of transportation. Each mode of transportation has its own unique set of characteristics which influence how transportation is performed, how the industry is organized, how prices are established, and the nature of government involvement. Although each mode is unique, the relevant characteristics can be classified to facilitate understanding.

Although each mode is rooted in a specific technology, there are two main components common to every modal system. These are the "right-of-way" and the vehicles which pass along the right-of-way. Some technologies, for example railroads, restrict the freedom of individual vehicles to maneuver. Railroad vehicles can only move where rails exist. Trucks on the other hand are operated independently of each other. A driver may select a lane and speed within the limits of rules, but his freedom is not physically constrained by the right-of-way as such. The ability of vehicles to maneuver under independent control determines the degree of traffic control imposed.

Operational traffic control may range from simple rules to complete centralized control of the speed and position of all vehicles. Some modes, notably railroads and pipeline, require complete control.

Other modes, including highway, marine and air, develop needs for stricter control for safety reasons or when a system, or parts of a system, become congested.

The need for traffic control has also historically determined the ownership of right-of-way systems. Railroad and pipeline operating companies have traditionally owned their own rights-of-way. Truck, bus, marine, and air transportation companies operate on public rights-of-way usually provided by governmental agencies.

Another characteristic of the transportation industry is the relationship between tons shipped and cost. In general, unit cost curves have been viewed as flat or declining. The actual shape of the cost curve is perhaps less important than the way it has been perceived. Typically, the marginal cost of loading and moving an extra unit of freight has been believed to be small and constant. This view of marginal costs is most applicable to situations where the basic right-of-way is in place and traffic levels are such that congestion is not significant.

The underlying technology and cost characteristics have in turn strongly influenced the size and number of firms participating in transportation markets. The large capital costs required for entry into railroad and pipeline transportation, due to the right-of-way investments necessary, have resulted in a smaller number of firms in these industries compared to other modes. Typically no more than a few railroads or pipelines serve particular markets and many markets are served by a single carrier. The truck and water transportation industries on the other hand are not faced with the need to make right-of-way investments and the number of firms in these industries is accordingly much larger. This has in turn influenced the degree of regulation imposed on the various modes.

The economic regulation imposed on various segments of the industry broadly covers ownership of transportation companies, mergers, entry and exit from transportation markets, rates, and services. The degree of regulation of various activities has varied over time and among modes.

Federal regulation of transportation was first imposed in 1877 on the railroad industry. Pipelines were brought under regulation in 1906. Both of these modes are still the most closely regulated today. Motor carriers were brought under regulation in 1935. The Great Lakes Trade Area of the water transportation industries was subject to varying degrees of regulation prior to 1940, the year in which all domestic water carriers were brought under nominal regulation. The trend today is to reduce federal regulation of all modes and rely more on competition.

CHARACTERISTICS OF MODES

The main economic characteristics of transportation modes which relate to commodity characteristics in the process of mode selection by shippers are:

- Cost to shippers.
- Flexibility (door-to-door service).
- Capacity (shipment size).
- Speed.

The four surface modes can be ranked according to their comparative advantages among the key economic characteristics. This ranking is shown in Table II-1 below.

It is important to note that pipeline and rail are the modes most competitive with water transportation (water transportation here includes coastal, Great Lakes and rivers) deep and shallow draft. Water transportation is "bracketed" by these two modes for all characteristics. Rail transportation, neither the "best" nor the "worst" for any characteristic, is potential competition for the entire range of commodities. A shippper faced with a decision to use water transportation or another mode would analyze the trade-offs among these advantages. The main advantages of water are cost and high volume capacity. Shippers requiring greater speed or flexibility may be willing to pay more to obtain these advantages from the rail mode.

It is also useful to keep in mind that the demand for transportation is a "derived demand". That is, goods are not moved about for the sole purpose of moving them. The demand for transportation arises when industries in different regions have cost and other advantages that enable them to meet demands for their goods in other regions at a profit. The mere existence or availability of a transportation system does not, by itself, generate movement of goods.

Table II-1

Comparative Advantages of Modes

Cost[1]	Flexibility	Capacity	Linehaul Speed
Pipeline- .3 to 1.0 cents/ton-mile	Truck- Can provide "door-to-door" service to almost any inland point	Pipeline- 30,000 to 2,500,000-ton unit capacity	Truck- 10 to 60 mph
Water- .3 to 3.0 cents/ton-mile	Rail- Rail sidings permit "door-to-door" service between many inland ports	Water- 1,000 to 60,000-ton unit capacity	Rail- 20 to 45 mph
Rail- 1.0 to 8.0 cents/ton-mile	Water- Range of direct service is *geographically limited* to areas adjacent to a waterway	Rail- 50 to 12,000-ton unit *capacity*	Water- 3 to 10 mph
Truck- 4.0 to 15.0 cents/ton-mile	Pipeline- Can offer direct service only to those mechanically linked to the system	Truck- 10 to 25-ton unit	Pipeline- 3 to 6 mph

NOTE: (1) 1977 Dollars.

SOURCE: A. T. Kearney

The characteristics of goods themselves vary widely. These variations, in turn, influence the selection of transportation modes. The characteristics of commodities which influence modal choice include:

- Value of the commodities.
- Perishability.
- Fragility.
- Susceptibility to bulk handling techniques.
- Shipment size.
- Volume over time.
- Density.
- Weight.
- Physical state.
- Reactiveness.
- Degree of hazard.
- Volatility.
- Frequency of movements.

INTERMODALISM

One important aspect of transportation and logistics that is often overlooked in discussions of individual modes is the importance of "intermodalism". Intermodalism is the use of two or more linehaul modes for the movement of goods. The term is often narrowly applied to movements which occur as joint movements under a single bill of lading. While these are important, intermodal shipments also occur through transshipment points, usually arranged by shippers. The first type (single bill of lading -- joint movements) are predominantly container and piggyback type operations usually of general cargo. This type of intermodal transportation is very important for water transportation on the ocean, both foreign and domestic trades.

The second type is more common on the inland water transportation systems, both rivers and Great Lakes. The fact that such movements do not occur under a single bill of lading means that documentation is lacking. Nevertheless, virtually all domestic water transportation movements require an additional move at either origin or destination, or both due to the limited numbers of points served. This is consistent with the inability of water transportation to provide complete "door-to-door" service. Thus intermodalism is extremely important in understanding water transportation in particular.

The fact of intermodal transportation is very important to understanding the competitive relationships among the different modes of transportation. While the different modes compete intensely for much traffic, they are also complementary for other traffic susceptible to intermodal movement, and also for the traffic for which they compete head to head. The main impetus for making use of intermodal transportation arises from the desire by shippers to take advantage of the different linehaul characteristics of different modes (cost, speed, or capacity). The role or importance of intermodalism is discussed at various points in this report where it is appropriate to go into greater detail.

INTERMODAL COMPETITION

While cooperation among the line-haul modes is important to overall efficiency, it is also important to understand the competitive mechanisms between modes. In general the two modes which own their own rights-of-way (rail and pipeline) will seek to retain as much traffic as possible on their own systems at the expense of potential intermodal opportunities. The other two surface modes on the other hand are not driven by self interest to adhere to any particular routing. Shippers in turn benefit from the fact that individual water and truck carriers will attempt to offer the most advantageous routings available because of the competitive pressures to do so. Thus, while competition within modes and among modes is beneficial to shippers, the different technological and institutional relationships that determine right-of-way ownership do not always support easy resolution of intermodal routing decisions, both in the short and long run.

RELATIVE IMPORTANCE OF MODES

(a) Transportation Performed

Two measures of transportation output are shown in Tables II-2 and II-3: Tonnage and Ton-Miles. Average lengths of hauls are shown in Table II-4.

Several important conclusions may be drawn from these tables.

1. Water transportation performs longer hauls than other modes.

2. The share of water transportation in the national freight market has been constant when measured in tons, and declined somewhat when measured in ton-miles.

3. The ton-mile share of rail in the national market for transportation has declined 39 percent from 1947 to 1977.

4. The modes experiencing the most rapid tonnage growth since World War II are pipeline and truck.

(b) Revenues Earned

The data in Table II-5 represent charges to shippers. These charges are not the same as revenues to carriers since the charges include estimates of costs for private carriage. The figures in Table II-5 also contain estimates of revenues for unregulated carriers. These estimates of charges to shippers can be combined with the data in Table II-3 to generate broad average costs per ton mile. This is done in Table II-6 for 1977.

Table II-2

Domestic Intercity Tonnage Transported by Surface Modes
(Millions of Tons)

	Year								Percent Change 1947-1977	
	1947		1957		1967		1977			
Mode	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	% Share
Truck	556	19.4	1,113	30.4	1,845	38.5	2,143	39.0	285	101
Rail	1,613	56.1	1,449	39.6	1,498	31.3	1,463	26.6	-9	-53
Oil Pipeline	238	8.3	441	12.0	679	14.2	1,005	18.3	322	120
Water	466	16.2	659	18.0	768	16.0	886	16.1	90	-1
TOTAL	2,873	100.0	3,662	100.0	4,790	100.0	5,497	100.0	91	

SOURCE: *Transportation Facts and Trends*, July 1979

Table II-3

Domestic Intercity Tonnage Transported by Surface Modes
(Billions of Ton Miles)

Mode	Year 1947 Ton-Miles	1947 Percent	1957 Ton-Miles	1957 Percent	1967 Ton-Miles	1967 Percent	1977 Ton-Miles	1977 Percent	Percent Change 1947-1977 Ton-Miles	Percent Change 1947-1977 % Share
Truck	102	8.3	254	16.0	389	19.5	555	21.9	444	164
Rail	665	53.8	626	39.5	731	36.7	832	32.9	25	-39
Oil Pipe-line	105	8.5	223	14.1	361	18.1	546	21.6	420	154
Water	364	29.4	480	30.3	513	25.7	598	23.6	64	-20
TOTAL	1,236	100.0	1,583	99.9	1,994	100.0	2,531	100.0	105	

SOURCE: Transportation Facts and Trends, July 1979
Waterborne Commerce of the United States, Part 5, 1977

Table II-4

Average Lengths of Hauls
(Miles)

Mode	Year 1947	1957	1967	1977
Truck	183	228	211	259
Rail	412	432	488	569
Oil Pipeline	441	506	532	543
Water	781	728	668	675

SOURCE: Computed from Tables II-2 and II-3.

SUMMARY

Each mode of surface transportation has its own characteristics that influence the organization of the carrier industries and most importantly, the characteristics of the services performed by each mode. Thus each mode has inherent strengths and weaknesses which influence the choices of shippers in which they balance considerations of flexibility, cost, speed, and volume.

The changes in market shares among the modes reflect in large part the changes in freight markets since World War II. Trucks have gained in importance primarily because they possessed speed and flexibility that made them very desirable to shippers of higher valued and packaged goods, of which more have been shipped each year as the economy grew and changed. Pipelines gained in importance because they were a low cost mode capable of handling the large and growing volumes of petroleum and petroleum products being shipped in stable markets where flexibility was less important. Thus the changing freight market combined with the modal characteristics have influenced the growth and evolution of the various transportation industries.

Table II-5

Estimated Costs to Shippers for
Domestic Intercity Surface Freight
(Millions of Dollars)*

Mode	1960 Dollars	1960 Percent	1970 Dollars	1970 Percent	1977 Dollars	1977 Percent	Percent Change 1960-1977 Dollars	Percent Change 1960-1977 % Share
Rail	9,028	31.0	11,869	24.5	19,581	21.1	117	-32
Truck	17,958	61.6	33,553	69.4	67,322	72.7	275	18
Oil Pipeline	895	3.1	1,396	2.9	2,641	2.9	195	-6
Water	1,286	4.4	1,546	3.2	3,108	3.4	142	-23
TOTAL	29,167	100.0	48,364	100.0	92,652	100.0	218	

NOTE: *Dollars are nominal current dollars for the years shown. None of these data have have been adjusted to a base year to reflect "real" dollars.

SOURCE: Transportation Facts and Trends, July 1979.

Table II-6

Costs per Ton Mile for Surface Modes, 1977(1)

	Rail	Truck	Oil Pipeline	Water
Charges in Millions of Dollars	19,581	67,322	2,641	3,108
Billions of Ton Miles	832	555	546	598
Cents per Ton Mile	2.35	12.13	0.48	0.52

NOTE: (1) The cents per ton-mile shown here are point estimates of national averages for all movements by each mode in 1977. These estimates fall within the ranges shown in Table II-1. The costs shown in both tables include only those linehaul costs borne by shippers.

SOURCE: Computed from Tables II-3 and II-5.

III - REVIEW OF WATER CARRIERS

DESCRIPTION OF WATERWAY SYSTEM

A map of the principal routes of the nation's domestic waterway system is shown in Figure III-A. The system has three major waterway trade areas: the shallow draft inland rivers (including the shallow draft coastal waterways), the Great Lakes, and the domestic ocean.[1] This distinction is drawn here because there are significant differences in marine operations in these trade areas, which in turn influence other aspects of the carrier industries in these trade areas.

To better understand the differences in trade areas and marine operations in general, it is important to review the major physical characteristics of the waterway system. These characteristics influence the types of equipment used, the nature of the services provided, and

---

1 The Shallow Draft Inland River Trade Area includes 1) the Mississippi from Baton Rouge to Minneapolis and its tributaries including the Missouri to Sioux City, Iowa, the McClellan-Kerr system to Catoosa, Oklahoma, the Illinois Waterway, the Ohio and tributaries, and the Tennessee to Knoxville, Tennessee, 2) the Columbia/Snake system to Lewiston, Idaho, 3) the Gulf Intracoastal Waterway, 4) the Atlantic Intracoastal Waterway, 5) the Black Warrior/Tombigbee system, 6) the New York State Barge Canal, and 7) other miscellaneous rivers, channels, and streams too numerous to mention. The Great Lakes Trade Area includes 1) the Great Lakes, 2) connecting rivers and channels, and 3) the St. Lawrence Seaway. The Domestic Ocean Trade Area includes 1) the open sea lanes connecting coastal ocean ports of the contiguous 48 states and the noncontiguous areas of Alaska, Hawaii, and Puerto Rico, 2) the deepwater ocean ports, and 3) the deep draft access channels to ocean ports.

Figure III-A

Selected Routes of Domestic Waterway System

the structure of the businesses which provide the transportation. The relevant characteristics of the waterway system are:

- Channel dimensions (width, and depth).
- Horizontal and vertical bridge clearances.
- Wave action.
- Route miles.
- Seasonality.
- Locks.
- Current.
- Tides.
- High water and/or low water.
- Radii of bends.

Not all of these characteristics are present or are of importance for all water carriers. For example, tides are not a factor on the Ohio River. On the other hand, wave action is a major concern for domestic ocean carriers. The relative presence or absence of these characteristics for a particular waterway routing has been a major influence on the development of the industry and the organization of the firms.

The basic waterway network is provided, maintained, and policed by public agencies. The primary federal agencies are the Corps of Engineers and the Coast Guard. The Corps has provided and maintained most of the channels, basins, dams, locks, breakwaters and jetties used as part of the navigation system. The Coast Guard, in addition to other responsibilities, provides aids to navigation, vessel traffic services, and ice breaking services. The system is operated as a public highway open to all users.

WATERWAY TRAFFIC

The characteristics of water transportation make it most competitive for the movement of bulk commodities. Prior to the development of the competing technologies of railroads and trucks, water transportation carried all types of goods and passengers. Today, domestic water transportation primarily competes for bulk goods. The mode does compete for nonbulk goods and passengers moving between the noncontiguous (Alaska, Hawaii, etc.) and the contiguous portions of the United States.

Reported waterway traffic for selected years is shown in Tables III-1 and III-2.

As noted in Table III-2, the ton-miles reported for 1947 and 1957 are not directly comparable to 1967 and 1977. The difference is in the treatment of movements transiting the ocean and other parts of the system. If the data were consistent, the earlier years would show fewer ton-miles on the Great Lakes and the rivers, and more on the ocean. Data on lengths of hauls are shown in Table III-3 for those years for which it is available.

Tonnages of major commodities shipped on the Nation's waterways in 1977 are shown in Table III-4.

The following conclusions can be drawn concerning traffic in the three trade areas based on the data presented:

1. The most rapidly growing trade area is the inland rivers and canals.

2. Traffic on the Great Lakes has declined absolutely and in relation to the other two trade areas.

3. The domestic ocean trade area has grown slowly.

4. The longest hauls occur on the ocean.

Table III-1

Domestic Water Transportation Shipping
(Millions of Tons)

Trade Area	Year 1947 Tons	1947 %	1957 Tons	1957 %	1967 Tons	1967 %	1977 Tons	1977 %	% Change 1947-1977
Rivers and Canals	150	32.2	281	42.6	399	52.0	529	59.7	253
Great Lakes	163	35.0	182	27.6	154	20.1	109	12.3	-33
Ocean	153	32.8	196	29.7	215	28.0	248	28.0	62
TOTAL	466	100.0	659	99.9	768	100.1	886	100.0	90

SOURCE: Transportation Facts and Trends, July 1979.

Table III-2

Domestic Water Transportation Shipping
(Billions of Ton Miles)

Trade Area	1947 Ton Miles	1947 %	1957 Ton Miles	1957 %	1967 Ton Miles	1967 %	1977 Ton Miles	1977 %	% Change 1947-1977
Rivers and Canals	35	9.6	115	24.0	128	25.0	202	33.8	477
Great Lakes	112	30.8	117	24.4	75	14.6	52	8.7	-54
Ocean	217	59.6	248	51.7	310	60.4	344	57.5	59
TOTAL	364	106.0	480	100.0	513	100.0	598	100.0	64

NOTE: * 1967 and 1977 are not directly comparable to 1947 and 1957 due to differences in data.

SOURCES: Transportation Facts and Trends, July 1979.
Waterborne Commerce of the United States, Part 5, 1977.

5. Length of hauls has been fairly constant on the Great Lakes and has increased on the rivers.

6. Bulk commodities or semibulk commodities account for very high percentages of traffic in all three trade areas.

Table III-3

Average Length of Hauls, Domestic Water Shipping
(Miles)

Trade Area	1955	1967	Year 1976	% Change 1955-1976
Rivers and Canals	256	322	376	47
Great Lakes	568	487	535	-6
Ocean	1,579	1,446	1,367	-13

SOURCE: Transportation Facts and Trends, July 1979.

Table III-4

Major Commodities in Domestic Waterborne Trade
(1,000 tons)

	Trade Areas						Total	
	Inland Rivers		Great Lakes		Ocean			
	Tons	%	Tons	%	Tons	%	Tons	% of Total
Petroleum Products	127,884	24.2	5,401	5.1	171,615	69.2	304,900	34.4
Coal	127,628	24.1	22,248	20.4	3,662	1.5	153,538	17.3
Crude Petroleum	48,623	9.2	0	0.0	30,732	12.4	79,355	9.0
Metallic Ores	7,087	1.3	44,315	40.6	10	*	51,412	5.8
Grains	45,589	8.6	1,456	1.3	907	0.4	47,852	5.4
Chemicals	26,431	5.0	461	0.4	9,215	3.7	36,107	4.1
Wood and Wood Products	19,717	3.7	177	0.2	1,534	0.6	21,428	2.4
Primary Metal Products	7,507	1.4	599	0.5	569	0.2	8,675	1.0
Fertilizer	3,062	0.6	2	*	160	0.1	3,224	0.4
Others	115,177	21.8	34,421	31.6	29,679	12.0	179,277	20.2
Total	528,705	100.0	109,080	100.0	248,083	100.0	885,868	100.0

NOTE: * Less than 0.1.

SOURCE: Waterborne Commerce of the United States, Part 5, 1977.

ORGANIZATION OF WATER TRANSPORTATION INDUSTRY

The number, size, and types of firms engaged in water transportation is highly influenced by the operating conditions and markets of the trade areas in which they are active. Most firms are oriented to only one trade area, or some part of a trade area. Firms that are active in more than one trade area are often divisionalized to correspond to the trade areas identified here. The number of companies reported by the Corps of Engineers is shown in Table III-5.

Table III-5

Number of Carriers by Area of Operation: 1976
(Includes private, exempt, and regulated carriers)

Area of Operation	Number of Firms
Mississippi River System and Gulf Intracoastal Waterway	1,022
Great Lakes	131
Atlantic and Pacific* Coasts	766

NOTE: *Includes deep draft and shallow draft operators.

SOURCE: U.S. Army Corps of Engineers, Transportation Series 3, 4 and 5.

There are a large number of firms engaged in water transportation, ranging in size from a single small towboat to very large common and private carriers. The technology of the industry makes entry feasible for new firms, since capital costs for water transportation companies are relatively low compared to pipeline and rail. The government provides an existing right-of-way network, unlike railroads and pipelines. The capital requirements are limited, therefore, to the amounts needed for equipment and working capital. This relative ease of entry enhances competition in the industry which is borne out by the large number of firms compared to pipelines and rail. This competition has in turn obviated the need for tight regulation. Only 6.9 percent of all domestic water traffic was subject to regulation in 1977. The competitive structure has in turn influenced rates and water transportation operations.

Given the relative lack of regulatory restrictions on entry and the relatively low capital requirements, the industry has evolved a variety of firms organized to meet the different requirements in the three trade areas and specific shipper needs. One major distinction is among major line-haul operations on major segments of the system, "branch line" operations on minor segments (in terms of traffic volumes), and local operations.

Line-haul carriers fall into two major categories. The first of these is shipper owned captive carriers (also known as private carriers). These may be operated as separate corporate entities or as divisions of larger firms whose main business is production, processing, or merchandizing commodities. Such firms engage directly in water transportation for many reasons, the most important of which is ensuring a minimum of logistics support for the main business. Other reasons include ensuring competitive rates from independent for hire carriers and diversification of operations into complementary lines of business. The availability of this option to shippers is a major factor ensuring competition in water transportation. Domestic ocean transportation of crude oil and petroleum products and Great Lakes transportation of iron ore are both major trades dominated by this type of corporate relationship. An example is the Great Lakes fleet operated by United States Steel.

The second major category of linehaul carriers is independent for hire firms. These firms are often also subsidiaries of larger companies, but they typically began as totally independent pure transportation concerns. They are independent in the sense that they are not owned by firms whose primary business is the production, processing, or merchandizing of commodities that happen to move by water. Rather, they often hold common carrier certificates for transportation of regulated commerce and compete for business from the full spectrum of shippers. While private carriers specialize in the types of goods they carry and the equipment they use to carry it, the large for hire independent carriers usually compete for a wide range of cargo. Therefore, independent carriers usually possess large diverse fleets of equipment, individual pieces of which may be highly specialized. An example is Federal Barge Lines. This second type of line haul carrier (independent) is more important in the inland

river trade area. This type is also important in the domestic ocean trades in general cargo between the contiguous 48 states and other United States territories and possessions.

There are some parts of the United States which are served by water transportation where traffic volumes are low. Consequently, the industry organization reflects this. Typically such markets are served by a few firms, most of which are small. Examples of such markets include isolated coastal reaches of Alaska and low traffic inland rivers such as the Missouri and the Kentucky. Equipment used in these operations may be highly specialized to meet unique local requirements such as lack of harbor tugs to assist in docking in isolated harbors, swift current conditions (*e.g.*, the Missouri River), or restrictive lock chamber dimensions and drafts (*e.g.*, the Kentucky River).

The third major category of firms is local for hire independent operators. These firms are almost all to be found in the inland river trade area and typically possess only a few small towboats and no barges. Such firms provide local harbor service and short linehaul movements of barges between isolated terminals and consolidation points (fleeting areas) for long distance line-haul movement.

In summary, the relative ease of entry, the availability of private transportation to shippers, and the diverse conditions under which water transportation is performed, have encouraged the formation of a large number of firms organized in a variety of ways to best meet the needs of shippers.

WATER TRANSPORTATION OPERATIONS

Water transportation operations vary widely among the three trade areas. Operations are influenced by physical conditions, technology, and industry organization. The trade areas are discussed in turn.

(a) Inland River Operations

The basic technology of inland river operations involves lashing individual barges together into a single unit called a tow. Early in the development of this type of barging technology towboats pulled barges, but subsequent developments led to the conclusion that the best position for the power vessel was at the rear of the tow. This positioning of the power and the use of multibarge tows is feasible because of the absence of significant wave action.

Other types of equipment used on the inland rivers include self-propelled and specialized barges. Self-propelled barges are used primarily on the New York State Barge Canel, since the small size of the locks and low level of traffic do not make the use of separable barges and towboats an efficient operation.

Some barges have also been developed over the years for special uses. For example, a special unit was developed for transporting Saturn rocket boosters to the Cape Canaveral Space Center. In addition, self-unloading barges for grain are commonly used on the Columbia River system.

Another type of inland river transportation is the transportation of log rafts on the Columbia River and its tributaries. This transportation is performed by floating the commodity, which is lighter than water, and then creating an integrated floating mass bound on the outside by a system of cables. This floating mass, called a raft, is then pulled by a towboat.

Inland river operations vary a great deal from river to river. The major variants are tow size, speed, and the horsepower of vessels used. Drafts also vary somewhat, but most equipment in use today will draw nine feet when fully loaded. The reason for this is that drafts are set by the shallowest controlling depth of the river segments on the route to be transmitted.

Nine feet is generally the controlling depth of channels, even though greater depths are available in many portions of the system. The tow sizes and depths for different river segments are shown in Table III-6.

Average operating speeds on inland rivers range from 3 to 6 miles per hour, depending primarily on the number of locks present. A recent study estimated average underway speeds on the Ohio River of 6.35 miles per hour which becomes an average of 4.10 miles per hour after delays are taken into account. Horsepower utilization is a fairly constant factor per ton shipped on the major segments of the river system. Thus horsepowers tend to vary in direct proportion to tonnages for at least 90% of the tons handled. On the less used branch lines of the system (e.g., the Missouri and the Kentucky) where channel configurations and depths are less favorable, higher horsepowers are used to handle the smaller size tows than the same horsepower would handle elsewhere. Based on the same study, horsepower per barge on the Missouri is estimated at 681 versus 310 on the Illinois River which is more representative of the main line system. This difference would be even greater if the smaller loadings per barge on the Missouri were considered.[2]

River operations are similar in certain respects to railroad operations. Historically, the simplest operation of river barges was like that of a way train railroad operation. A way train is a train that moves between two points with many intermediate stops for dropping off or adding cars to the train. Historically, many river operations were conducted in this manner. This type of operation requires a high degree of equipment standardization, and is compatible with small markets.

---

2 The source for all the data cited in this paragraph is the Vessels Characteristics Survey conducted by the St. Louis District of the Corps for the Water Resources Support Center.

Table III-6

River Operating Characteristics

Name	Common Maximum Tow Size (35' x 110' Jumbo Barges)	Controlling Depths
Upper Mississippi	15	9
Middle Mississippi	25	9
Lower Mississippi	45	9
Baton Rouge to Gulf	45	40
Illinois Waterway	15	9
Missouri	4-6	8-9
Ohio	15	9
Monongahela	4(1)	9
Allegheny	4	9
Kanawha	9	9
Kentucky	(2)	Less than 6
Green/Barren	4	9
Cumberland	8	9
Tennessee	15	9
Arkansas	9	9
Ouachita	2	Less than 9
Atchafalaya	6	10-12.9
Morgan City-Port Allen	5(3)	10-12.9
Gulf Intracoastal Waterway, West	5(3)	10-12.9
Gulf Intracoastal Waterway, East to Carabelle, Florida	5(3)	10-12.9
Gulf Intracoastal Waterway, East (remainder)	2-5(3)	Less than 8
Houston Ship Canal	5(3)	40
Black Warrior/ Tombigbee	6	9
Alabama/Coosa	2	9
Appalachicola, Chattahoochee, Flint	1	9
Atlantic Intra-coastal Waterway	(4)	Less than 17(5)
Hudson River/New York State Barge Canal	1	10-43.9
Columbia/Snake	7(6)	13-17.9

NOTES: (1) Monongahela River tows use six "stumbo" (195' x 26') or larger number of "standard" (175' x 26') barges equivalent to four jumbos.

(2) Maximum lock dimensions on the Kentucky are 38' x 145'. Maximum tow size is three very small barges. The largest barge in use today is 35' x 140'.

(3) Jumbo barge equivalents.

(4) Feasible maximum tow size is considered to be two standard barges.

(5) Some reaches have less than 8 feet.

(6) Columbia/Snake tows use five (220' x 42') barges equivalent to seven jumbos.

SOURCE: National Waterways Study, Engineering Analysis of Waterways Systems.

These operations are also compatible with small tow sizes and the participation of more than one towing company in the actual haul. As traffic volumes increase, tow sizes increase (navigation conditions permitting) to gain linehaul efficiencies. Extremely high point-to-point volumes lead to even more specialized operations. This type of operation is highly characteristic of the grain trade of the Upper Mississippi above Cairo and its tributaries.

The "integrated tow" is becoming important as an alternative type of river operation, similar to the "unit train" concept. A unit train is a dedicated movement of one type of transportation equipment between two specific points with no stopping in-between for adding or subtracting cars from the train. Integrated tows are tows carrying high volumes of traffic between specific points. They are typically made up of box barges without rakes on either end, with "end places" having a single rake. This presents a smoother bottom surface to the water, increases line-haul operating efficiency by about five percent, and provides more cargo space.[3]

Integrated tow operations are most effective for large volumes of traffic between fixed origins and destinations normally handled under contract arrangements. Contracts are necessary to encourage operators to make the necessary investment and commitment of the equipment and personnel to the operation. Such operations are most common with large scale coal transportation operations.

---

3 A barge or vessel which has a rake has a bow or stern which is angled instead of vertical. The angling reduces resistance when moving through the water. When raked barges are incorporated into a tow voids are created in the middle of the two which increase drag. Hence the use of box barges without rakes in integrated tows makes linehaul operations more efficient.

Integrated tows are also extensively used by tank barge operators on the Gulf Intracoastal Waterway. This is because the tank barge dimensions used on that Waterway are somewhat different in order to make optimal use of narrow lock and channel dimensions on that waterway. Most of these barges are wider than normal hoppers.

When a river barge operation is not an integrated tow operation, the barges will pass through fleeting areas which have a function similar to classification yards in the railroad industry. Trains originate in railroad yards and pass through the railroad system to yards for disposal. The yards are located at major junctions and terminal areas. Similarly, barge fleeting areas are established at key river junctions, near terminals, and in major ports for temporary storage of barges in transit.

For example, a major fleeting point is Cairo, Illinois, where upbound tows are broken into smaller tows for operation on the Upper Mississippi and Ohio Rivers. Conversely, downbound smaller tows are consolidated into larger tows for linehaul operations on the Lower Mississippi River. The availability and efficiency of fleets today is viewed as a constraint to the continued growth of the industry.

There are two types of fleets, anchor fleets and bank fleets. Anchor fleets are built around an anchor barge permanently moored offshore. Bank fleets are physically attached to the shore. The basic technology of fleeting has changed little over the last several decades and fleet inefficiency is seen as a drag on linehaul productivity. Furthermore, fleeting activities are also seen as hazardous to workers and other vessels, with breakaway barges a too frequent occurrence. Inadequate fleeting capacity is perceived as a constraint by some operators and may in fact be a physical constraint in isolated areas. Based on other studies, however, it is apparent that fleet utilization can often be improved or adequate fleets can be provided, but at a greater cost[4].

---

4 Barge Traffic Forecast and Constraint Analysis for Great II, January, 1980.

Other services are also provided to the river transportation industry, many of which are handled through markets rather than through an integrated corporate operation. For example, large towboats typically remain in service for extended periods of time. The periods of service exceed the ability of the towboats to carry fuel and other expendable supplies. Therefore, a specialized service industry has developed to provide these materials to the linehaul operators. This industry is called the "midstreamer" industry. The midstreamer provides fuel, food, and other miscellaneous expendable items. The supplies are transferred to the linehaul towboat in midstream while the tow is under way.

Other service industries have developed to support the linehaul operations. These include repair yards, barge cleaning operations, spill containment operations, insurance operations, equipment leasing companies, and the provision of an open exchange for barge freight at the St. Louis Merchant's exchange. These operations are flexible and are designed to provide efficient utilization of resources for linehaul operators and shippers.

A waterway route is served by a carrier when there is a sufficient one-way movement that will justify the investment in an ongoing operation. However, goods do move in both directions on most rivers. The two-way movement of goods provides some opportunity for carriers to make more efficient use of their equipment at lower cost to all their customers by engaging in what is known as "backhaul" transportation.[5]

An example is the transportation of fertilizer up the Mississippi River to the grain producing areas of the Midwest. This is a backhaul to the grain fronthaul downstream. Fertilizer is considered a backhaul because there

---

5 Backhaul movements are movements utilizing equipment which would otherwise travel empty on a return trip for re-loading. Fronthaul is the converse of backhaul. Fronthaul movements are one-way loaded trips which would absorb the cost of empty returns and take place even in the absence of backhaul movements.

is less of it to be moved and the grain fronthaul would probably occur in the same amounts even if the backhaul were not available. Solicitation of backhaul transportation depends upon carriers' ability to include backhaul movements in the schedule yet meet their commitments for the fronthaul movements. One basic trend in all transportation is for equipment to be increasingly specialized. Therefore, it is not always possible for a backhaul movement to be efficiently carried.

Thus for backhaul movements to occur three conditions have to be met:

1. There has to be a two-way flow of commodities.

2. The fronthaul and backhaul commodities have to be able to use the same equipment.

3. The backhaul rates have to be attractive enough to offset the advantages of a dedicated fronthaul movement.

A sample calculation of a breakeven backhaul rate is shown in Table III-7.

Table III-7

Backhaul Breakeven Analysis, Fertilizer from New Orleans to Davenport, Iowa*

Fronthaul Movement	Equipment Type	Cleaning Costs	Fronthaul Revenue Loss	Breakeven Backhaul Rate
Grain-Davenport to New Orleans	35' X 195' Covered Hopper	$500	$ 5,234	$3.95/ton

NOTE: * Based on prevailing Rates in Autumn, 1979.

SOURCE: NWS Working Papers

The breakeven backhaul rate is two times the sum of out-of-pocket cleaning costs and fronthaul revenue loss during downtime for moving a barge from its unloading point to a cleaning service, cleaning, and placing the barge for reloading. This would occur at the end of each trip. The revenue loss is based on the long-term grain rates in the fall of 1979. In a tight spot market situation, the fronthaul revenue loss can be much greater.

The manner in which transportation operations are performed on the inland rivers also has implications for the organization of the industry. It is technically possible for many companies to participate in the movement of a particular trip and such interlining and/or subchartering is common. Thus market signals are introduced into many aspects of operations that would not occur if operations were controlled by a single company. These market signals are used by flexible managements to make effective operations and long-range decisions. Examples of the kinds of options available to management include tow sizes and speeds, and whether or not to subcontract part of a haul. This flexibility, combined with marketplace discipline, makes the entire system efficient.

(b) Great Lakes Operations

Water transportation on the Great Lakes uses both barges and self propelled vessels, relying primarily on the latter. The reason for this is the wave action on these larger bodies of water which precludes barging operations like those on the river. The vessels used have the bridge in the bow leaving the midship portion of the deck clear.

While the vessels engaged in domestic commerce are protected from foreign competition, virtually all of the foreign trade on the Great Lakes (excluding Canadian traffic) is carried in foreign flag vessels. American Flag vessels do not participate in the foreign trade moving on the Great Lakes (except Canadian trade) and through the St. Lawrence Seaway because several factors

make these operations more costly compared to use of coastal ocean ports. Briefly these conditions are:

1. Restricted vessel dimensions because of locks (105' x 1,000' through the Po Lock and 75.5' x 730' in the Seaway).

2. Restricted channel depths (27' or less).

3. Increased transit times over land routes.

4. Difficult access channels at some ports.

5. Restricted dock dimensions and depths at some terminals.

6. Lack of year-round navigation.

Other competitive factors such as attractive railroad rates to coastal ports and competition from foreign flag carriers have also tended to reduce American Flag participation in much of the Great Lakes foreign trade.

All of these factors have retarded the growth of both domestic and foreign Great Lakes commerce. Also important for domestic commerce are:

1. The limited number of routes served.

2. Circuity of Lakes routes over other surface modes.

3. Slowly growing markets for bulk commodities carried on the Lakes.

As a result of all these factors the Great Lakes fleet is generally old and highly standardized. Much of the fleet is owned by shippers as a private operation.

Conventional barges are used on the Great Lakes but their usefulness is limited by available technology and practices. The barges which are used must also be constructed to withstand greater wave action. Barge tows on the Great Lakes are much smaller than tows on rivers. The

wave action precludes a river type of operation. These factors (barge vulnerability and restricted tow size) have historically favored self-propelled vessels over barges on the Lakes. Most barges are used for relatively short trips close to the shore.

The nature of Great Lakes operations, the amount of commerce, and the concentration of commerce on two industries (steel and electric utilities) has resulted in a carrier industry with fewer firms operating in a stable environment. The orientation of the carrier industry (both for-hire and private) is to the unique logistics requirements of its major customers on specific limited trade lanes. Thus there is less opportunity for services that are not specifically tailored to these needs. The customers themselves own large fleets of vessels and effectively control operations.

Two areas of growth potential could influence Great Lakes operations. These are further growth in grain exports, and domestic movements of coal, particularly Western coal. Growth in these markets may encourage service improvements.

(c) Domestic Ocean Operations

Water transportation operations serving the domestic market are strongly influenced by the physical conditions of the operating environment and the economic marketplace. The physical conditions include significant wave action, restricted harbor depths, and vessel size limitations imposed by the Pamana Canal (106' x 900' x 30'). Wave action on the ocean has limited the effectiveness of coventional barge operations and has resulted in most commerce being carried in self-propelled vessels. Depth limitations in harbors and size restrictions at the Panama Canal have not posed physical constraints restricting the ability of the industry to meet demand, but have made marine operations more costly, and hence less competitive with other surface modes for trade among the contiguous 48 states.

Virtually all the traffic in non-bulk goods among the contiguous states has been lost to other modes. Water transportation remains important for all types of goods between the contiguous 48 states and Alaska, Hawaii and Puerto Rico. However, operations of non-bulk vessels (containers and RO-RO) are restricted by the size of these markets. The most important types of self-propelled vessel operation are tankers carrying crude petroleum and petroleum products. This was true even before the initiation of shipments of crude oil from the Alaskan North Slope. However, the opening of the Alaskan pipeline in 1977 has made ocean shipments of crude oil an even bigger share of the domestic ocean operations.

One historic trend in domestic ocean (and international) operations has been to operate vessels at ever greater speeds. This practice was pursued to reduce crew and vessel costs and to improve service. With the rapid rise in fuel costs in recent years, some operators have reduced the speeds at which they operate their vessels. This is particularly important for the higher speed liner services since propulsion power required varies approximately with the cube of the speed. Lower operating speeds are expected to be the norm for the foreseeable future.

Although conditions in the domestic ocean favor self-propelled vessels operations, barges are used in all trade lanes to at least some degree. Barges have two advantages over self-propelled vessels, lower labor costs and the ability to penetrate shallow inlets and rivers (particularly in Alaska), and fuel savings. Nevertheless wave action has remained a dominant design and operational consideration.

This has led to the use of notched barges in integrated tug barge operations. Notched barges have an indentation in the stern for the insertion of the bow of a power vessel. This creates greater resistance to longitudinal movements along the interface between the barge and the power vessel, and enhances control under adverse conditions. Such barges also tend to be much larger than conventional barges used on the inland river system and Great Lakes. They can take advantage of

greater drafts and are not constrained by locks and river bends. Ocean bargers in service today carry as much as 40,000 tons.

WATER TRANSPORTATION EQUIPMENT AND TECHNOLOGY TRENDS

The water transportation industry has been very creative in its development of different types of equipment for different situations. Most of the equipment in use today is oriented toward the transportation of bulk commodities, because of the inherent advantage of water transportation in the transportation of bulk commodities.

Each trade area of the water transportation system has its own constraints and advantages. These have influenced the technological adaptation to those characteristics. However, there are certain underlying trends for the entire industry including:

1. Increases in vessel carrying capacity.

2. Improvements to reduce turnaround time at ports and terminals.

3. Changes in operating speeds.

4. Increases in linehaul efficiency through better hull design.

5. Improvements in navigation, communications, and safety equipment.

6. Improvements in "engine room" efficiency to improve fuel consumption through use of new engine designs, computer controls, use of waste heat, etc.

One basic trend has been the development of new types of specialized equipment and it is probable that new types of specialized equipment will continue to appear. Specialized equipment is generally costlier to design and build, precisely because of its limited applications. Therefore, while new equipment types will appear as part of an ongoing trend, the pace of development is set by

particular requirements of the marketplace. Integrated tows are used to some degree in all major trades on the river system. Integrated tows are most common in the West Gulf Coast Region where tank barges dominate traffic. The fleets and technology trends in each trade area are discussed in turn later in this section.

(a) Inland River Equipment

For carriers operating on the river system, the most common equipment includes barges, and towboats to move the barges. The 1976 fleet of barges is shown in Table III-8 below.

Table III-8

Number of Barges by Type, Mississippi River and Gulf Coast

	Barge Type				
	Open Hopper	Covered Hopper	Deck	Tank	Total
Number	9,768	6,443	2,312	2,985	21,508
Aggregate Capacity (1,000 Tons)	12,342	8,896	1,796	6,391	29,425
Average Capacity in Tons	1,263	1,381	777	2,141	1,368

SOURCE: Army Corps of Engineers, Transportation Series 4, 1976.

The barges reported are believed to include a small number of very large ocean going barges (up to 19,000 tons capacity). The number is so small, however, that it does not distort the discussion that follows.

The open hopper fleet is used to transport coal, rock, and other dry bulks not susceptible to weather damage. Coal is the largest volume commodity carried in these barges. The small average barge capacity results from the fact that much of this fleet operates on tributaries of the Ohio River, which have restrictive lock dimensions.

In contrast, the average capacity of the covered hopper fleet is very near to the nominal capacity of the normal jumbo (35' by 195') barge. This reflects the fact that the most important cargo shipped in these barges, grain, originates mostly on the Illinois Waterway and the Upper Mississippi where the locks are largely standardized at 110' by 600'. The grain trade also requires greater uniformity of equipment to facilitate reconsignments and diversions en route by shippers. Almost 80 percent of the covered hopper fleet in 1976 was of the conventional dimensions.

Deck barges are few in number and smaller in size. These barges are used for transporting waterways materials (rip rap, piling, etc.) to job sites, and for working platforms. The need for maneuverability in tight circumstances dictates smaller sizes for these barges.

Tank barges are the largest barges in the fleet on average. This reflects the need to optimize barge designs for narrow (55') locks on the Gulf Intracoastal Waterway and standard width (110') locks elsewhere. Barges 50' in width were reported as accounting for 35 percent of individual tank barges in 1976 and 46 percent of total tank barge capacity. These larger barges push the average tank barge capacity above the maximum for a normal jumbo barge. The larger tank barges are also often segregated into compartments. This allows carriers to accept smaller consignments yet gain the line haul efficiencies of larger barges. This is particularly important for chemicals. Other liquid products moving in unsegregated tanks move in larger consignments than is customary for dry bulk trades. Also contributing to larger sizes for tank barges is the greater use of dedicated equipment.

Additional information on trends in barge fleet capacity and barge size is shown in Table III-9 on the following page.

As can be seen from Tables III-5, III-8, and III-9, the barge fleet on the Mississippi and Gulf Intracoastal systems has grown rapidly to handle the large increases in commerce in this trade area. Not only has the total fleet increased, but the average barge size has increased substantially which has helped improve productivity in the industry.

Towboats in use on the inland rivers range in size from a few hundred horsepower to very large boats of 10,500 horsepower. Over 50 percent of the towboats range below 1,400 horsepower. The trend has been to use larger boats in ever larger tows. Thus, the larger boats also tend to be newer. The average age in 1976 was less than 15 years, indicating a growing fleet with many new additions.

Trends in the towboat fleet in this trade area are shown in Table III-10.

As can be seen from Table III-10 the fleet of available towboats has increased but at a much slower rate than the fleet of barges. Aggregate horsepower has increased at almost the same rate as barge capacity however. Thus average towboat horsepower has almost quadrupled during the thirty year period shown.

This has been the main source of the increased productivity seen in this industry since World War II. The larger towboats have gone hand in hand with larger tow sizes. However, the growth in average tow size is expected to slow down.

Although recent years have seen the construction of several of the extremely large towboats, some operators indicate that they do not expect to acquire any more of the largest size. Apparently fuel cost increases have not been offset by other productivity gains. Nevertheless,

Table III-9

Trends in Barge Fleet Capacity and Barge Size, Mississippi River and Gulf Coast

	1948		1957		1965		1976		1978*		%Change 1948-1978	
	Number of Barges	Capacity (1,000 Tons)	Number of Barges	Capacity (1,000 Tons)	Number of Barges	Capacity (1,000 Tons)	Number of Barges	Capacity (1,000 Tons)	Number of Barges	Capacity (1,000 Tons)	Number of Barges	Capacity (1,000 Tons)
Dry cargo barges	4,431	3,372	8,348	7,418	10,679	11,132	18,049	22,255	19,809	25,149	347%	646%
Tank barges	1,419	1,576	1,672	2,547	2,031	4,037	2,979	6,295	3,250	6,717	129%	326%
TOTAL	5,850	4,948	10,020	9,965	12,710	15,169	21,028	28,550	23,059	31,866	294%	544%
Average Barge Capacity	846 Tons		995 Tons		1,193 Tons		1,358 Tons		1,382 Tons		63%	

NOTE: *Data for 1978 are as of October 1978.

SOURCE: U.S. Army Corps of Engineers, Unpublished Data.

Table III-10

Trends in Towboat Horsepower
Mississippi River and Gulf Coast

	1948		1957		1965		1976		1978		% Change 1948-1978	
	Number of Towboats	Horsepower (1,000 HP)	Number of Towboats	Horsepower (1,000 HP)	Number of Towboats	Horsepower (1,000 HP)	Number of Towboats	Horsepower (1,000 HP)	Number of Towboats	Horsepower (1,000 HP)	Number of Towboats	Horsepower (1,000 HP)
Towboats	1,502	639	1,852	1,227	2,023	1,698	2,541	3,575	2,632	4,073	75%	537%
Average Horsepower	425 HP		663 HP		839 HP		1,407 HP		1,547 HP		264%	

SOURCE: U.S. Army Corps of Engineers, Unpublished Data.

average fleet horsepower should continue to increase as more boats ranging from 3,000 to 7,000 horsepower are brought into the fleet.

Typical costs in 1980 for river equipment were $4,100,000 for a 5,600 horsepower towboat, $260,000 for a jumbo covered hopper barge, and $460,000 for a jumbo tank barge.[6]

The basic technology of river equipment is well developed. Therefore, increases in linehaul productivity will result from continued replacement of older equipment with equipment based on existing concepts. No new radical developments are expected in linehaul equipment.

Applications of up-to-date technology are expected to modify fleet efficiency over time in the following areas:

1. Larger barge sizes for special applications (e.g. super jumbos for some coal movements).

2. Larger tow capacities on unrestricted rivers.

3. Newer towboats with more efficient propulsion mechanisms (possibly including variable pitch propellers) and engines.

4. Limited application of self unloading barges in congested terminal areas and for unique products (e.g., cement).

5. More efficient engines which develop more horsepower at the propeller shaft for the same amount of fuel.

6. Better communications.

7. Computerized asset management.

8. Increased use of integrated tows.

---

6 Data from American Waterways Operators.

Improvement in existing technology may occur in the means by which tows are held together. The existing cable technology has several advantages. These are:

1. Inexpensive.

2. Facilitates combination of different types and sizes of barges in a single tow.

3. Facilitates combination of loaded and empty barges in a single tow.

4. In universal use, guaranteeing equipment compatibility and carrier interlining.

Conversely, there are disadvantages of the existing technology, including:

1. Dangerous to use.

2. Subject to unpredictable failure.

3. Significant time consumed whenever it is necessary to make or break a tow.

Improved barge latching devices could be adopted resulting in a substantial impact on linehaul productivity. This concept would be most applicable in an integrated tow operation, where interlining between carriers is not a consideration and all the barges in a tow are the same size and are always loaded to the same depths.

(b) Great Lakes
Equipment

The fleet of barges operating on the Great Lakes in 1976 is shown in Table III-11 and the fleet of self propelled U.S. Flag vessels of 1,000 gross tons or more on the Lakes is shown in Table III-12.

Compared to the Mississippi and Gulf Coast Systems, the barges operating on the Great Lakes are fewer in

Table III-11

Number of United States Barges by Type, Great Lakes

	Open Hopper	Covered Hopper	Deck	Tank	Total
Number of Barges	127	2	63	51	243
Aggregate Capacity in Tons	244,288	4,101	63,494	109,896	421,779
Average Capacity in Tons	1,924	2,051	1,008	2,155	1,736

SOURCE: Army Corps of Engineers, Transportation Series 3, 1976.

number with less fleet capacity. Average capacity is greater for all types of barges, however, indicating that lock dimensions are a less serious constraint on barge size. In addition, there is a virtual absence of covered hopper barges in the Great Lakes fleet. The main cargo for these barges, grain, is carried in self propelled lake bulkers.

The number of vessels and total capacity have decreased since World War II. Average vessel size has increased 109 percent during this period of time as old vessels are retired and replaced with vessels sized to more fully utilize newer, larger lock chambers on the St. Mary's River. Season extension programs of recent years have also increased vessel utilization, allowing fewer vessels to handle the same commerce.

Table III-12 also shows the increased importance of self-unloaders. This is the only vessel type which has experienced an increase in aggregate capacity since World

Table III-12

Self Propelled Lake Vessels in Domestic Trade

Vessel Type/Trade	1951 Number of Vessels	1951 Capacity (1,000 Tons)	1961 Number of Vessels	1961 Capacity (1,000 Tons)	1971 Number of Vessels	1971 Capacity (1,000 Tons)	1981 (1) Number of Vessels	1981 (1) Capacity (1,000 Tons)	% Change 1951-1978 Number of Vessels	% Change 1951-1978 Capacity (1,000 Tons)
Bulkers - Ore/Coal Trade	265	2,636	210	2,792	135	2,042	135	2,657	-56%	-10% (2)
Self Unloaders-Bulk Freight	42	331	53	502	50	559				
Bulkers-Mixed Trade	43	183	23	114	5	21	12	72	-70%	-61%
Tankers	29	115	26	113	17	73	8	57	-72%	-51%
Total	379	3,265	314	3,521	207	2,695	155	2,786	-59%	-15%
Average Vessel Carrying Capacity	8,600 tons		11,200 tons		13,000 tons		18,000 tons		109%	

NOTE: (1) Data for 1978 varies significantly from previous years. A separate count of self unloaders is no longer maintained by the Association. The figures also include 4 barges, including one 1,000 ft. integrated tug barge.

(2) Percent change computed for Bulkers-Ore/Coal Trade and Self Unloaders-Bulk Freight combined.

SOURCE: Annual Reports, Lake Carriers Association, Various Years.

War II. The increase in self unloaders (including conversions) has been undertaken to reduce vessel turnaround times. These vessels are also able to call at ports with limited unloading facilities.

Tugs and towboats in use on the Great Lakes are both smaller and older than those in use on the rivers. Average size was about 1,300 horsepower and average age was slightly more than 24 years in 1976. These data are consistent with the smaller number of barges per tow on the Lakes and the stable market for Lakes shipping.

The present domestic Great Lakes fleet has been shaped by its operating conditions and its markets. The loss of packaged goods and other higher value cargo to other surface modes has left a fleet oriented primarily to serving the needs of the steel industry and electric utilities. Ore, coal, and limestone (used for flux in steelmaking) accounted for 86 percent of domestic Lakes commerce in 1977. Thus the future fleet will be strongly influenced by these factors as well. Future technological trends are likely to include:

1. Continued replacement of older, smaller vessels with larger vessels.

2. Continued addition of self-unloaders.

3. Vessel modifications such as hull strengthening and modifying bows for winter conditions if season extension programs become permanent.

4. Engine room efficiencies to improve fuel consumption.

5. Possible further adaptation of integrated-tug-barge concepts (discussed more fully under ocean equipment below).

(c) Domestic Ocean Equipment

The domestic fleets of barges, and self propelled cargo vessels engaged in domestic ocean trade are shown in Tables III-13, and III-14 respectively.

Table III-13

Inventory of United States Barges, Atlantic, Pacific, and Gulf Coasts

	Open Hopper	Covered Hopper	Deck	Tank	Total
Number	3,270	112	1,572	603	5,557
Aggregate Capacity in 1,000 Tons	3,264	332	1,056	2,387	7,048
Average Capacity in Tons	998	2,964	672	3,975	1,268

SOURCE: Army Corps of Engineers, Transportation Series 5, 1976.

Table III-14

Self-Propelled United States Vessels in Domestic Ocean Trade in 1976

	Vessels	Capacity (1,000 Tons)
Dry Cargo Vessels	796	4,945
Tankers	296	8,662

SOURCE: United States Department of Commerce, Domestic Waterborne Trade of the United States, 1973-1977

One point must be made about the interpretation of the data in Table III-13. The Transportation Series published by the Corps of Engineers is organized regionally by the addresses of the reporting carriers' offices. While this does not make much difference for Series 3 and 4, Series 5 includes carriers engaged in ocean trade and inland trade. Thus oceangoing and non-oceangoing equipment are mixed in these tables. The preponderance of the barges in particular is probably involved in non-ocean activities.

Fewer barges are used in this trade generally. Equipment sizes are more variable, although tank barges and covered hopper barges are generally larger than similar barges used on the Mississippi system. Equipment compatibility and interchangability are less important considerations in this trade. Tugs tend to be smaller than towboats in use on the Mississippi. There is one tug to every 3.6 barges compared to one towboat for every 8.3 barges on the Mississippi. More of the power vessels reported in Series 5 are used as harbor tugs. Nevertheless, tows are smaller on the waterways outside the Mississippi and Gulf Intracoastal System.

As can be seen from Table III-14, most of the capacity of the United States flag self propelled fleet serving the domestic ocean trade area is tanker capacity. The present composition of the dry cargo fleet also reflects the effects of the "container revolution." Unitized cargo as a concept was first applied in United States domestic trade. Both containerships and "roll-on/roll-off" ships are American inventions and today dominate world trade in general cargo as well as the domestic ocean trades in nonbulk dry cargo.

These concepts were developed to hold down port costs for vessels by expediting loading and unloading. Beneficial effects on service have also been realized and port congestion reduced.

Another important concept in use in the domestic ocean trade is the integrated-tug-barge for bulk cargoes. In addition to providing flexibility in equipment utilization, the integrated-tug barge has different manning

requirements, making it more economical than self propelled vessels of similar capacity.

In general the domestic ocean fleet is less constrained in the ways in which innovation can be applied. Although harbor depths are restrictive by world standards, the controlling depths are nevertheless deeper than in other domestic trade areas. Channel restrictions on vessel size are minimal and there are not locks to contend with except for the Panama Canal. The basic technology trends in the Domestic Ocean trade area since World War II include:

- Larger vessel size.
- Higher operating speeds.
- Unitized cargo.
- Integrated tug barges.

Several of these advances (larger vessel size and unitized cargo) have been exploited as fully as possible at this time given system constraints. Significant advances are expected in three areas:

1. Further application of integrated tug barges.
2. Engine room improvements to improve fuel efficiency.
3. Reduced design operating speeds for new vessels in liner trades.

(d) Equipment Used in Foreign Trade

A detailed review of the water transportation industry serving foreign trade and the equipment used by it was not included in the scope of the research effort for this study element of NWS. Nevertheless it is desirable to point out a few facts about waterborne foreign trade that relate to NWS study objectives. First, most of the foreign trade of the United States is carried in foreign

flag vessels (vessels registered in other countries). Many of these vessels are owned by American companies but are operated under foreign registry for a variety of reasons, including lower operating costs.

Since World War II the most rapidly growing component of world trade has been trade in crude petroleum and petroleum products. This trade has been carried in a growing fleet of large tankers. The largest of these, known as Ultra Large Crude Carriers, are vessels of 350,000 deadweight tonnage and up. No American port is capable of receiving the largest vessels in operation in the world today. Although no additional vessels larger than the largest in existence today may be built, the average size of the world trade fleet is expected to continue to increase as older smaller vessels are removed from the fleet.

The same trend exists for dry bulk carriers as well, with many modern vessels capable of handling both liquid and dry bulk cargoes. This increasing use of larger vessels in world trade, combined with steps in other nations to provide deeper harbors, will tend to make the United States less competitive in the world trade of bulk commodities.

Most coal loading terminals in the United States, for example, are restricted to accepting vessels between 50,000 and 70,000 deadweight tons. Where larger vessels can be accommodated at piers, they cannot be fully loaded due to depth restrictions. These result in a cost penalty to United States shipowners and coal exporters in turn, of about 10 cents per ton. The cost for a 60,000-ton vessel is estimated at $0.333 per ton compared to $0.235 per ton for a 150,000-ton vessel.[7]

---

7 Moving United States Coal to Export Markets (draft report), June 1980.

FINANCIAL PROFILE OF CARRIERS

Most domestic water carriers are not subject to economic regulation and are not required to report financial data in a uniform format to regulatory bodies. Furthermore, most firms are either closely held entities or subsidiaries of other firms and do not release annual reports to the public. Therefore, published financial information for the industry is essentially non-existent. Consequently, to develop a financial profile of the industry, financial data was solicited from firms involved in domestic water transportation. A mail survey was undertaken in 1979 with the assistance of the American Waterways Operators, Inc. Enough responses were received to support analysis. In general, the data represent companies offering transportation for hire, although some private carriers may have been included in the analysis. The responses were screened, however, to include only those carriers operating as separate corporate entities. Twenty one responses were used for the analysis.

Most of the respondents were operators on the Mississippi River and its tributaries. Some Lake carriers and coastal operators were included in the final analysis. The average balance sheet of the sample firms is shown in Table III-15.

Several observations can be made from these data:

1. A high percentage of fixed assets is devoted to floating equipment. This reflects the fact that the right-of-way is publicly provided and shore facility needs are minimal.

2. Current Assets exceed Current Liabilities, but firms are not highly liquid.

3. The reporting firms have healthy capitalization. The aggregate debt/equity ratio is less than two.

An average Income Statement for the sample is shown in Table III-16.

Table III-15

Domestic Water Carrier
Representative Balance Sheet
(In Thousands of Dollars)

ASSETS	
Current Assets	
Cash	$ 710
Other Current Assets	4,489
Total Current Assets	5,199
Fixed Assets	
Floating Equipment	$22,468
Less Depreciation	(7,399)
Non-Floating Equipment	970
Less Depreciation	(320)
Net Property and Equipment	14,999*
Land and Other Holdings	456
Other Assets	1,269
Total Assets	21,440*
LIABILITIES AND EQUITY	
Current Liabilities	$ 4,907
Long-Term Debt	8,348
Reserves	4,281
Total Liabilities	14,752*
Total Equity	6,688
TOTAL LIABILITIES AND EQUITY	21,440*

NOTE: * Totals do not equal the sums of their components due to averaging.

SOURCE: A. T. Kearney NWS Survey Data.

Table III-16

Domestic Water Carrier
Representative Income Statement
(In Thousands of Dollars)

REVENUES	
Barge Freight	$19,533
Towing Operations	2,029
Other	2,225
TOTAL REVENUES	$21,429*
EXPENSES	
Fuel	$ 2,954
Maintenance/Repairs	1,737
Wages, Salaries, Fringes	2,991
Depreciation	1,640
Administration	1,474
Other	8,615
TOTAL EXPENSES	$18,561*
GROSS INCOME	$ 2,578
NET INCOME (after taxes and interest)	$ 505

NOTE: * Totals do not equal the sum of components due to averaging. Gross Income does not equal difference between revenues and expenses due to averaging.

SOURCE: A. T. Kearney NWS Survey Data, 1978 base year.

The following observations can be made about the income statement information:

1. The average results for the reporting companies indicate a viable industry. The average operating ratio (expenses divided by revenues) was 87 percent, which is good for transportation companies (95 percent for reporting motor carriers and 97 percent for railroads).

2. The return on fixed assets (net income divided by fixed assets less depreciation) was three percent. This is low compared to manufacturing industries. The return before taxes and interest was 16 percent.

3. Return on equity (net income divided by equity) was eight percent, which is in the midrange for transportation companies.

These results are sufficient to ensure continued availability of capital to the industry. This view was confirmed by all the carriers interviewed who indicated that obtaining capital was no problem. One recent development that has begun to change the water transportation industry is the growing use of major equipment leasing firms. This is a new form of financing for the industry and many carriers indicated an awareness of it. No data on the significance of leasing at this time exist however.

Although most carriers interviewed believe that capital availability is not a problem, this view is not universally shared. To the extent that operational and ratemaking decisions are predicated on historic capital costs, current profits may not be sufficient to generate the returns required by future investors to provide the needed capacity. One manufacturer (Dravo) recently cited a cost for a simple jumbo hopper barge which is almost four times greater today than what it was in 1963. The failure of revenues to cover capital replacement costs, while potentially serious, is not by itself unique to water transportation, nor affecting it adversely compared to other modes. In addition to the traditional sources of capital for equipment, equipment leasing in the industry has increased in recent years, adding to the potential sources of funds.

The operating results reported in this survey, compared to a similar survey convering the period 1967-71, reveal a decline in key indicators. Net income increased only three percent and return on fixed assets after taxes and interest declined from five percent to three percent. More assets are being deployed to earn essentially the same after tax profit. Operating ratios have become less favorable, increasing from 72 percent in the earlier period to 87 percent in the new survey. The period

covered by the new survey was 1978, prior to the increase in fuel prices in 1979.

The carriers interviewed indicated that several factors have adversely affected the industry in recent years. These include severe winters, declining productivity, increased congestion at locks, less reliable channels due to reduced dredging, and fuel cost increases. Other factors which may explain the less favorable financial results are the rapid expansion that has occurred in the industry and the maturing technology of the industry. In addition, competition among the carriers passes the benefits of water transportation to shippers and tends to reduce profitability.

ECONOMIC REGULATION

(a) General

Economic regulation of domestic water transportation is more limited and less complex than that imposed on other modes of transportation. Restrictions on ownership, entry, exit, rates, and financial reporting are limited to a small segment of waterborne commerce. Since competition is more extensive in the industry and private transportation is an alternative for shippers, they have not sought strong regulation. The relative importance of regulated waterborne commerce can be seen in Table III-17.

The degree of regulation ranges from 13.3 percent on the Inland River Trade Area to 0.4 percent on the Great Lakes. In all trade areas regulation is relatively unimportant.

One aspect of economic regulation affecting all water carriers is the Panama Canal Act. Passed in 1912, this law generally prohibits railroads from owning water transportation companies except under certain circumstances. The law has generally been construed to cover all types of water carriers, including Great Lakes and inland river carriers, although it was written with intercoastal trade between the Atlantic and Pacific coasts in mind. It has effectively prevented the formation of significant bimodal rail and water transportation companies.

Table III-17

Ton-Miles and Type of Domestic Water Traffic, 1977
(Billions of Ton Miles)

Trade Area	Exempt, For-Hire	Private	Regulated	Total	% Regulated
Inland River	151.6	22.3	27.9	201.8	13.8
Great Lakes	13.6	13.6	0.2	52.4	0.4
Domestic Ocean	170.0	160.2	13.3	343.5	3.9
TOTAL	360.2	196.1	41.4	597.7	6.9

SOURCE: Waterborne Commerce of the United States, Part 5, 1977.

(b) Regulation of Inland River Transportation

River transportation was first brought under federal regulation by Congress with the Transportation Act of 1940. Authority was given to the Interstate Commerce Commission to regulate rates and entry into the industry. However, bulk commodities were exempted from regulation. This has had the practical effect of applying regulation to a small part of the industry. For several years the law subjected bulk commodities to regulation under either of two conditions. These were the mixing of regulated and unregulated commodities in the same tow and three or more unregulated commodities in the same tow. These provisions were not effectively enforced, and were recently removed from the law.

Regulated commerce consists primarily of iron and steel products. Rates are published in tariffs by the Waterways Freight Bureau. Tariffs governing other commodities not handled as bulks (e.g., bagged sugar) are also published by this bureau.

Some states also have laws on their books regulating barge traffic. Generally these laws have little effect since most barge traffic is interstate commerce. Intrastate regulation usually is confined to for-hire commerce and much short haul intrastate waterborne commerce is private (e.g., sand and gravel). Furthermore many states have no laws at all governing intrastate waterborne commerce. State regulation can be important for unique individual movements (e.g., sludge on the Illinois Waterway) but these are very minor tonnages compared to the total. Other state regulatory activities, such as on dredging restrictions, do have an economic impact on carriers.

At least as important as the absence of rate regulation is absence of artificial barriers to entry into the industry. The absence of barriers and relatively low capital costs has eased the formation of new firms to provide competition and new services.

(c) Regulation of Great Lakes Transportation

Water transportation by common carriers on the Great Lakes was brought under regulation by the Shipping Act of 1916. Jurisdiction was given to a new "Shipping Board". Jurisdiction was transferred to the Interstate Commerce Commission in 1940. The bulk commodity exemption discussed above was also applied to Great Lakes traffic in 1940. Less than one percent of Great Lakes domestic traffic was subject to regulation in 1977.

(d) Regulation of Domestic Ocean Transportation

Regulation covered slightly less than four percent of total domestic ocean traffic in 1977. Most of this regulated traffic probably moved under the jurisdiction of the Federal Maritime Commission.

The regulation of domestic ocean for hire common carrier water transportation was first imposed by the Shipping Act of 1916. The same provisions made for the Great Lakes were also made for coastal operations. Today jurisdiction over this trade is very limited and divided between two agencies. Jurisdiction over traffic between ports in the contiguous 48 states resides with the Interstate Commerce Commission. Jurisdiction over traffic between the contiguous 48 states and Alaska, Hawaii, Puerto Rico and other possessions rests with the Federal Maritime Commission. The Federal Maritime Commission is the successor body of the Shipping Board.

One important law particularly affecting this commerce is the Jones Act, passed in 1920. This law requires that commerce carried between American ports including Alaska, Hawaii and Puerto Rico be carried by American owned and operated vessels built in the United States. The law is policed by the Treasury Department through its customs Service. The law excludes foreign built and operated vessels from the trade and thereby protects American shipyards, vessel operators, and labor. The law does not impose regulation directly on rates but has the effect of limiting competition by restricting entry into markets by an entire class of competitors. The Jones Act is only the most recent of a series of "cabotage laws" limiting foreign competition for domestic waterborne carriage.

RATE STRUCTURE

(a) General

Rates charged for for-hire water transportation can be classified as either regulated or exempt and as either contract or spot rates. Regulated rates by definition apply only to regulated commerce and are published in tariffs. Exempt rates are rates for water transportation which is not subject to regulation and can be either spot rates or contract rates. As noted earlier, most waterborne commerce is of bulk commodities and is not subject to regulation. Due to the absence of economic regulation for most of the industry, it is possible for carriers to engage in contract arrangements with shippers. Typically these rates will cover several items:

1. Length of time of the contract.

2. Nature of the service to be provided.

3. Cost of the service to be provided.

4. Conditions under which the service is to be provided.

5. Circumstances under which the contract may be voided.

6. Provisions covering cost escalation.

Usually the minimum period for a contract rate is one year, although contracts can run to several years. Longer contracts are more likely to be used when large investments of equipment will be required to perform the contract. Contract rates may or may not include escalation provisions to cover increased costs.

Carriers generally have preferred to solicit contracts in order to establish a reliable traffic base. The commitment of equipment to contract insures high utilization and enables carriers to obtain financing for capital investments which might not otherwise have been available.

There is also an active spot rate market. Spot rates are normally considered to be rates for single barge or vessel operations; that is, a spot rate covers a single loaded movement from one point to another. All movements of regulated commodities are, in essence, spot rates. Spot movements also occur for nonregulated bulk commodities.

Typically, spot rates have been higher than contract rates, in order to provide carriers with a premium to cover the risk of entering the spot market. The risk for carriers arises due to the possibility of low utilization of equipment. The trading of grain barge freight contracts on the St. Louis Merchant's Exchange provides an opportunity for mitigating this risk through hedging.

(b) Inland River Rates

River barge rates have the same contract/spot rate structure as discussed above. The relative absence of economic regulation allows ratemaking flexibility in the industry. For unregulated commodities contract rates normally cover 80 to 85 percent of all traffic, with wide variance among carriers and commodities over time.

For example, liquid chemicals are more likely to move under contract. Grain rates on the other hand have been particularly vulnerable to cost pressures and high demand in recent years. This has created a situation where the spot market has been more active with more traffic moving at spot rates.

Nonbulk commodities also move by barge. This traffic is regulated by the Interstate Commerce Commission and carriers must publish tariffs for this traffic. The most important commodity moving by barge under published rates is iron and steel products. Grain carriers in the Northwestern states on the Columbia/Snake River System also choose to publish their rates, but are not required by law to do so.

Due to the relative absence of regulation, no comprehensive data on rates and rate trends are available for most river transportation. Published data regarding rate trends for barges are available only for regulated carriers and are shown in Table III-18.

While the data shown in Table III-18 are for regulated barge commerce only, they may be considered to be representative of all barge rates. Unregulated barge commerce has a similar cost and rate structure as regulated commerce and is subject to the same economic influences.

Nominal barge rates declined from 1965 to 1972. This decline in nominal rates implies an even stronger decline in real rates (adjusted for inflation). This decline in rates shown in Table III-18, was a continuation of a trend

that began after World War II but reversed itself in 1973. Thus, nominal barge rates have increased rapidly in recent years.

Table III-18

Trends in Regulated Barge Rates

Year	Average Cents Per Ton-Mile	Index (1965=100)
1965	.346¢	100
1970	.303	88
1971	.339	98
1972	.328	95
1973	.381	110
1974	.492	142
1975	.518	153
1976	.507	146
1977	.550	159

SOURCE: Transportation Facts and Trends, July, 1979.

Major factors influencing today's barge rates are increasing fuel costs and increasing congestion at major bottlenecks on the river system. All modes of transportation have been adversely affected by increasing energy costs. However, river carriers have been unusually affected in that energy cost is a higher percentage of their total operating cost than for one of their major competitors, railroads.

The other major factor contributing to the recent rise in river carrier rates is congestion at key bottlenecks. Major bottlenecks at locks and selected port facilities reduce the utilization of equipment. Lower utilization in turn necessitates higher rates for carrier's equipment.

(c) Great Lakes Rates

Most transportation on the Great Lakes is provided under contract rates or long-term charters, with 26

percent of transportation service performed by private carriers. Therefore, there is no major spot rate market for traffic.

(d) Ocean Rates

Domestic ocean movements include both long term contracts or charters, and spot rates. Spot rates tend to be higher than long-term charters for the reason noted previously. Some charters or contracts for domestic ocean movements can be extremely long, lasting up to ten years. Such contracts may be entered into by large shippers with special requirements, in order to encourage carriers to make the necessary investments in specialized equipment.

The markets for the deep draft vessel transportation on the Great Lakes and in the domestic ocean are largely established by brokers specializing in this trade.

(e) Pricing Strategy

There are two major factors influencing pricing strategy in the water transportation industry which differentiate it from other surface modes. These are the absence of "value of service" ratemaking practices and the ability of most shippers to engage in private carriage for the full range of their water transportation needs without regulatory restraint. Both are the result of the competitive nature of the industry.

"Value of service" ratemaking is a form of price discrimination which charges more for shipping higher valued goods than for lower valued goods. Maintenance of any price descrimination system requires a degree of market control by carriers which is absent in the case of water transportation. "Private carriage" is the transportation of one's own goods in one's own equipment. Private carriage is an option for shippers using water transportation and this also limits the degree of control that water carriers can exercise over markets.

The inability of carriers to exercise monopoly control over routes (except for limited examples of regulated common carriage), minimizes the possibility of price discrimination such as "value of service" pricing. No examples of long-term contract ratemaking that are not cost based were uncovered in the interviews, nor have been reported in the literature.

The basic strategy followed by most carriers is to closely monitor all costs and quote rates which will provide an adequate return on investment. The target ROI's cited by carriers ranged from 5 percent to 20 percent. The same targets are pursued in both contract and spot markets. The carriers interviewed indicated that a wide range of percentages of spot versus contract rates across the firms interviewed was used in the conduct of business. The range is indicative of different approaches to risk taken by firms in the absence of regulation.

Private carriers operated as independent entities pursue similar strategies as for-hire, independent carriers. However, private transportation operations managed as a cost center are somewhat different. Typically these operations are viewed as service or cost centers for the primary business. Profitability generally is not an objective but returns on investment are considered. All shippers interviewed who ran such operations expressed a willingness to reply on for-hire carriers when it is more economical to do so. Thus private "rates", or intracompany charges, are also cost based and very competitive with for-hire charges.

INTERMODALISM

Intermodal transportation occurs where more than one mode of linehaul transportation is used between the origin and destination of the same goods. Both bulk and nonbulk goods can be shipped intermodally. The goods may or may not be containerized and may or may not move on a single bill of lading. Very few shipments are made via water transportation that are not intermodal. An additional movement by some other surface mode typically occurs at either the origin or destination or both. The fundamental reason for this is the limited direct access of water carriers to geographic markets.

There are few economic and technological barriers to greater use of water transportation in cooperation with other modes. Intermodal shipments are hampered at some existing terminals which are not suited to existing high volume barge movements. Some terminals also lack adequate physical facilities for interfacing with other surface modes, also limiting intermodal shipments. Even where adequate facilities exist, railroad rates may not favorable for intermodal movements.

The primary barriers are institutional and include:

1. Legal restraints on integrated ownership and management of multimodal firms.

2. Orientation of carrier management philosophy towards a single mode.

3. Railroad ratemaking practices.

Recent years have seen some promising changes in attitudes that have let to more cooperation between modes. Examples are grain feeder movements by rail to rivers in the Midwest on a few railroads and Western coal brought by rail to river terminals (e.g., Burlington Northern Coal movements to St. Louis and Metropolis, Illinois for transloading onto barges).

Intermodalism also is important between deep draft carriers of general cargo and other surface modes. The rapid development of containerization after World War II has greatly facilitated this. A more recent development has been the substitution of long haul rail movements of containers in dedicated trains to points traditionally served by different ports. For example, containers originating in the Midwest which might have traditionally moved to a Gulf port for ocean shipment to the Far East can now move by "mini-bridge" to a West Coast port.

GOVERNMENT SUBSIDIES/ FINANCIAL SUPPORT

There are two significant government programs affecting the private costs and financing of water

transportation. These include publicly provided port and waterway infrastructure with little or no cost recovery, and financing aids for capital equipment.

(a) Infrastructure/ Right-of-Way

Historically, the United States government has chosen not to charge water carriers for the use of navigation facilities provided by the government. These facilities include river improvements, locks on the Great Lakes, and harbor improvements on the Great Lakes and on the coast. This policy continues to be re-evaluated. At the present time, inland river carriers will begin paying a fuel tax on October 1, 1980. The fuel tax increases incrementally from four cents a gallon on October 1, 1980 to 10 cents a gallon on October 1, 1985. This fuel tax is designed to correct a perceived inequity among modes of transportation and improve efficient utilization of resources. However, it was not designed or installed with a specific coast recovery scheme in designed or installed with a specific cost recovery scheme in mind. To the extent that the cost of different facilities and traffic levels vary, some users will subsidize others under this scheme.

The ongoing user charge study mandated by PL 95-502 may result in changes in the user charge system. The key questions are: 1) the level of cost recovery, and 2) the manner of cost recovery. User charges oriented at recovering segment specific costs from traffic actually using the segments are likely to make water transportation uncompetitive on some segments. This would result in some segments falling into disuse with project abandonment a potential action. User charges which are general in nature, such as a fuel tax, will result in cross subsidization among segments. Loss of traffic on "marginal" segments under fuel tax is less likely. Some traffic diversions throughout the system will be likely in any case.

The stated objective of user charges is to make users pay. Those shippers who continue to use water transportation subject to user charges will of course pay more for the service. The carriers cannot absorb the cost and

competition assures that charges will be passed on. This outcome was confirmed in all the interviews.

Where states or other local jurisdictions have invested public funds in port facilities they can, and do, recover these costs through user fees for their facilities.

(b) Title XI

Title XI of the Merchant Marine Act of 1936 established the initial Federal Ship Financing Guarantees Program. The original program provided only for loan insurance. The 1972 amendments to the Act established direct government guarantees. Guarantees are not available to American buyers and operators of United States built vessels for up to 87 1/2 percent of the actual cost of new vessels. The amount and terms of the guarantee vary by the type of vessel, the amount of foreign components incorporated into a vessel, and the financial condition of the applicant.

The program is self-financing. Recipients of guarantees pay annual insurance premiums based on the government's exposure. The monies are held in a fund used to cover defaults. Up to september 30, 1978, only 10 companies had ever defaulted.

As of fiscal year 1978 a total of 4,127 vessels and barges were covered by Title XI contracts for a total principal amount of 5.7 billion dollars. Sixty-five percent of the dollar coverage was accounted for by 257 deep draft vessels, with the balance covering over 3,800 other types of equipment including river barges and towboats, and drill rigs. While Title XI guarantees have been available to owners of deep draft vessels for several years, only in recent years have owners of shallow draft towboats and barges made use of the law. The law tends to hold down capital costs for owners of marine equipment. Since the subsidy is only an interest subsidy it is not clear that the law has important impacts on owners of marine equipment or whether it encourages more or less investment.

(c) Other Subsidy Programs

The Federal Maritime Administration also administers other programs which subsidize construction of ships in the United States and American flag operators of deep draft vessels. These programs include:

1. Construction Differential Subsidy -- which is designed to reduce or eliminate the disparity between United States and foreign shipbuilding prices, with various restrictions.

2. Capital Construction Fund -- which defers federal income taxes on funds deposited with the Administration by certain classes of deep draft operators to promote ship investment.

3. Construction Reserve fund -- which defers taxes on gains through disposition of vessels by United States flag operators (including inland waterway operations) to encourage upgrading of the United States fleet.

4. Operating Differential Subsidy -- which provides funds directly to U.S. flag operators in foreign trades to offset their higher costs compared to foreign flag operators.

All these programs, combined with the Jones Act, are intended to preserve and enhance U.S. shipbuilding capabilities and an active merchant marine for defense purposes. The economic benefits to the industries are obvious. The programs have relatively little effect on domestic waterborne commerce and other subface modes except for the domestic ocean trades. In addition to these direct subsidy programs MARAD also administers a number of other promotional and research development activities, primarily oriented at deepdraft nevigation.

REGULATIONS

(a) Environment

Several environmental regulations and restrictions impinge upon water transportation (e.g., the Coastal Zone

Management Act of 1972, Section 404t of the Clean Waters Act of 1977, and the Endangered Species Act of 1973, to name a few). Most of these relate to the restrictions placed upon the Corps of Engineers in the way in which the navigation facilities are constructed, operated, and maintained. Delays have been encountered in constructing improvements to the system to provide additional capacity. Also, the Corps of Engineers has experienced greater costs and difficulties in maintaining existing facilities. The most notable restraint on existing operations is the restraint on dredging. This is a restraint that applies not only to rivers but also to harbors. Restrictions on open water dumping of dredged materials have reduced the ability of the Corps to dredge and increased the cost where dredging is allowed. The result has been increased groundings on the Mississippi River and gradual silting of some harbors.

Once a waterway is in place, the actual operations of barges, towboats, and vessels have been found to have negligible environmental impacts, with one exception. The exception relates to spills of hazardous cargo. Nevertheless, liability penalities have been proposed at various places and times which could preclude water transportation of hazardous substances from some markets.

(b) Safety

General marine safety is the responsibility of the U.S. Coast Guard. The Coast Guard maintains and operates navigation aids (lighthouses and channel markers), certifies all self-propelled vessels and some barges used for certain classes of cargo, licenses individual crew members, provides search and rescue services, and polices environmental laws as they apply to navigation. In addition the Coast Guard has responsibilities for bridges as they affect navigation under the Truman-Hobbs Act. As mentioned earlier, the Coast Guard also has responsibility for ice breaking and cleaning up spills of oil and other pollutants. The Coast Guard as an agency has more direct impact on day to day marine operations than any other federal agency. Coast Guard activities are favorably perceived by the water transportation industry as being necessary and productive and not adversely affecting marine capabilities.

IV - REVIEW OF RAIL CARRIERS

INTRODUCTION

The first common carrier railroad in the United States was the Baltimore and Ohio (B&O), which commenced service with 14 miles of track in 1830. The B&O and other early railroads were initially developed to complement the existing system of canal transportation. Most of early operations were local and independent; therefore, the railroads could not then be considered a major part of the nation's transportation system.

Construction of railroads accelerated rapidly after the passage of the Federal Land Grant Act of 1850. This act provided land along rights-of-way as an added inducement to railroad construction. The railroads used the land for the placing of trackage and for the raising of capital to assist in the actual construction. In exchange, the railroads granted reduced rates on government freight and passengers. The objectives of the act were achieved with the rapid expansion of the rail system, for by the time of the Civil War, there were more than 30,000 route miles.

In addition to the land grants for railroad construction, there were other efforts devoted to capitalizing on the financial opportunities of the new industry. For example, companies were created for the purpose of building new rail lines. This pattern was not in response to any particular rational planning process, but was based on the desire of railroad investors to profit from the expansion effort. As a consequence of this haphazard method of development, the rail network of the late 1800s and early 1900s included many competing and duplicate lines. This occurred in the heavily industrialized areas in the Northeast, as well as the then-developing areas, such as the Dakotas, Iowa, Nebraska, and Kansas.

This overconstruction has plagued the industry up to this day, with the carriers still attempting to eliminate unneeded facilities through mergers, consolidations, and line abandonments. The federal government examined the problem early in the century, culminating in the passage

of the Transportation Act of 1920. This law required the ICC to develop a master plan for the consolidation of the railroads into a smaller, more logical rail system. Efforts to develop such a plan were slow in coming; consequently, there have been no significant results.

ROUTE STRUCTURE

The building of the railroad system was a major factor in the development of significant portions of the country. However, with the advent of the highway system and the improved level of service offered by motor carriers, the importance of rail service for a community became less significant. The railroads found themselves with a continually declining share of the high-valued, time-sensitive freight.

Improvements in the inland waterway system and construction of pipelines also proved to be substantial competition in areas in which such service was available. These developments resulted in some loss of the bulk-type commodities that the railroads had previously handled.

As shown in Table IV-1, the railroads' share of intercity ton-miles dropped from 61.3% in 1940 to 35.6% in 1977. While the railroads' share of the traffic has dropped, ton-mileage has increased from 579 billion ton-miles in 1960 to 870 billion ton-miles in 1978, indicating a slower growth rate than the total transportation market (2.3% for rail versus 3.4% for the total market on an annualized basis).

Even with increases in the overall level of rail tonnage, there is still a considerable excess of rail trackage in the United States. Some carriers have contended that 40% of their trackage generates only four percent of their revenue. This situation is not uncommon, and may be representative of the industry as a whole.

Faced with the costliness of maintaining the excess capacity that exists within the industry, efforts have been continually made toward reducing the size of the rail

system. In 1977 there were 191,205 miles of railroad line in the United States, a substantial reduction from the 249,433 miles in 1929 (see Table IV-2). Between 1970 and 1977, the size of the rail system was reduced by 7.3%.

Table IV-1

Percent of Intercity Ton Miles by Mode

Year	Rail	Truck	Pipeline	Great Lakes	Inland Water	Air
1940	61.3	10.0	9.5	15.5	3.6	0(1)
1950	56.2	16.3	12.1	10.5	4.9	0(1)
1960	44.1	21.8	17.4	7.5	9.2	.1
1970	39.7	21.3	22.3	5.9	10.6	.2
1977	35.6	24.1	24.0	4.1	12.0	.2

NOTE: (1) Less than .1%

SOURCE: Moody's Transportation Manual, 1979.

Table IV-2

Miles of Railroad Line in the United States

Year	Miles	Year	Miles
1929	249,433	1967	209,826
1939	235,064	1968	208,648
1944	227,335	1969	207,526
1947	225,806	1970	206,265
1951	223,427	1971	205,220
1955	220,670	1972	203,299
1962	215,090	1973	201,585
1963	214,387	1974	200,916
1964	212,603	1975	199,126
1965	211,925	1976	192,396
1966	211,107	1977	191,205

SOURCE: Association of America Railroads, Yearbook of Railroad Facts - 1979.

Most railroads have analyzed their systems and have developed detailed plans for eliminating undesirable sections of trackage. For the most part, the identified sections of track are localized in nature and, therefore, affect only a particular area. In addition to individual rationalization efforts which are small in scale, there could be much larger abandonments resulting from the reorganization or liquidation of the carriers presently in bankruptcy.

In 1980, the Rock Island Railroad ceased to operate as a common carrier railroad. For years, efforts had been made to keep the entire system going. The failure to reduce the size of the physical plant and to maintain the most promising portions of this plant ultimately led to the demise of the carrier.

The future will definitely result in a much smaller rail system in terms of the number of route miles, as well as the number of carriers. Some industry observers have indicated that the eventual system may be only two-thirds the size of the present system. However, the overall impact of the reduction in size will not be of the magnitude of the reduction in mileage because of the elimination of duplicate or seldom-used trackage.

INDUSTRY PROFILE

Changes occurring in the composition of the industry and the traffic mix will be reviewed in this section.

(a) Carriers

The number of rail carriers has declined substantially over the years, mainly as the result of purchases, mergers, and consolidations. In 1920 there were 1,085 operating railroads; through consolidation, this number had decreased to 314 by 1976 (see Table IV-3). The concentration within the industry becomes even more apparent when the significance of the Class I carriers (those with revenue in excess of $50 million) is identified. The 42 linehaul Class I carriers account for 99% of total rail

traffic, operate 94% of the rail mileage, and employ 92% of all railroad personnel. See Exhibit IV-1 for list of Class I carriers.

Table IV-3

Number of Operating Railroads

Year	Operating Railroads	Operating Railroads Over 1,000 Miles of Road
1900	1,224	48
1910	1,306	54
1920	1,085	55
1930	775	54
1940	574	45
1950	471	43
1960	407	39
1970	351	30
1976	314	26

SOURCE: Moody's Transportation Manual, 1979.

The merger efforts of the industry continued into the 1960s and 1970s, as carriers sought to strengthen their competitive positions and penetrate new markets. Most of the significant mergers were between railroads with essentially parallel systems. It was believed that significant savings could be achieved through the reduction of duplicate lines with the same service continuing to be offered; however, the savings have generally failed to reach projected levels. The Penn Central bankruptcy slowed the trend toward parallel mergers, as many industry officials began questioning the reasonableness of cost reductions resulting from this approach.

The Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act) has substantially eased the merger process for railroads, and it now appears that the composition of the industry may be altered as the result of some key mergers. Those presently being considered are end-to-end rather than parallel mergers, involving connecting rather than competing carriers. Examples would be the Burlington Northern/Frisco, the Family Lines/Chessie and

the Union Pacific/Missouri Pacific Mergers. Benefits will be derived from increased average length of haul, reduced interchange costs, and a strengthened competitive position. These types of mergers should make the railroads much more competitive in the transportation marketplace.

(b) Revenue

In 1978 the railroad's freight revenue was $20.3 billion, an increase of 7.6% over the previous year. The rail industry has generally achieved growth in total revenue, but in many cases the growth has not been enough to cover increases in costs. This problem area will be discussed in later sections of this chapter.

The composite revenue patterns of the railroad industry can be misleading. There have been substantial shifts in the distribution of rail revenue toward the Southern and Western carriers at the expense of the Eastern carriers. Table IV-4 shows that the Eastern carriers' share of the total revenue has declined from 42.4% in 1955 to only 29.0%. This is the result of changes in traffic mix, population shifts, industrial relocation, deteriorating rail service in the Northeast, and increased competition from motor carriers. The financial implications can be seen by the plight of Conrail, and by the relative strength of the Western and Southern carriers.

(c) Railroad Traffic

In the early years, the railroads were often the only reliable form of transportation. A broad mixture of commodities was handled in addition to passenger traffic. However, this situation has changed substantially, especially over the last 30 years.

The makeup of the industries that traditionally used rail has been changing, with new facilities not necessarily being geared toward rail. In addition, the speed and flexibility of motor carriers captured much of the higher valued commodities that railroads previously handled. This trend is continuing as the cost of inventories continues to increase for commodities that

Table IV-4

Railroad Freight Revenue by District

Year	Eastern District		Southern District		Western District	
	Revenue ($ 000)	Percent Of total	Revenue ($ 000)	Percent of total	Revenue ($ 000)	Percent of total
1955	$3,616,086	42.4%	$1,212,785	14.2%	$3,709,415	43.4%
1965	3,443,217	39.0	1,353,989	15.3	4,038,751	45.7
1975	3,169,425	33.6	2,635,094	17.1	7,585,290	49.3
1978	3,906,175	29.0	3,772,236	18.3	10,704,530	52.7

SOURCE: Association of American Railroads, Yearbook of Railroad Facts, 1979.

traditionally moved by rail. The higher cost of motor carrier service is offset in many cases by a reduction in inventory costs because of the smaller order quantities when specifying truck delivery, and the generally faster and more reliable transit times.

The railroads' present commodity mix consists of large quantities of bulk types of commodities and those manufactured or processed materials that move in large quantities between a few points. Figure IV-A illustrates those commodities important to the railroads in terms of revenue generation. Four commodity groups (coal, food products, farm products, and chemicals) account for almost half of the revenue. It is significant to note that all four commodity groups can and do utilize competitive modes: coal, farm products, and chemicals move in large quantities on the inland waterway system; motor carriers move large quantities of food and farm products.

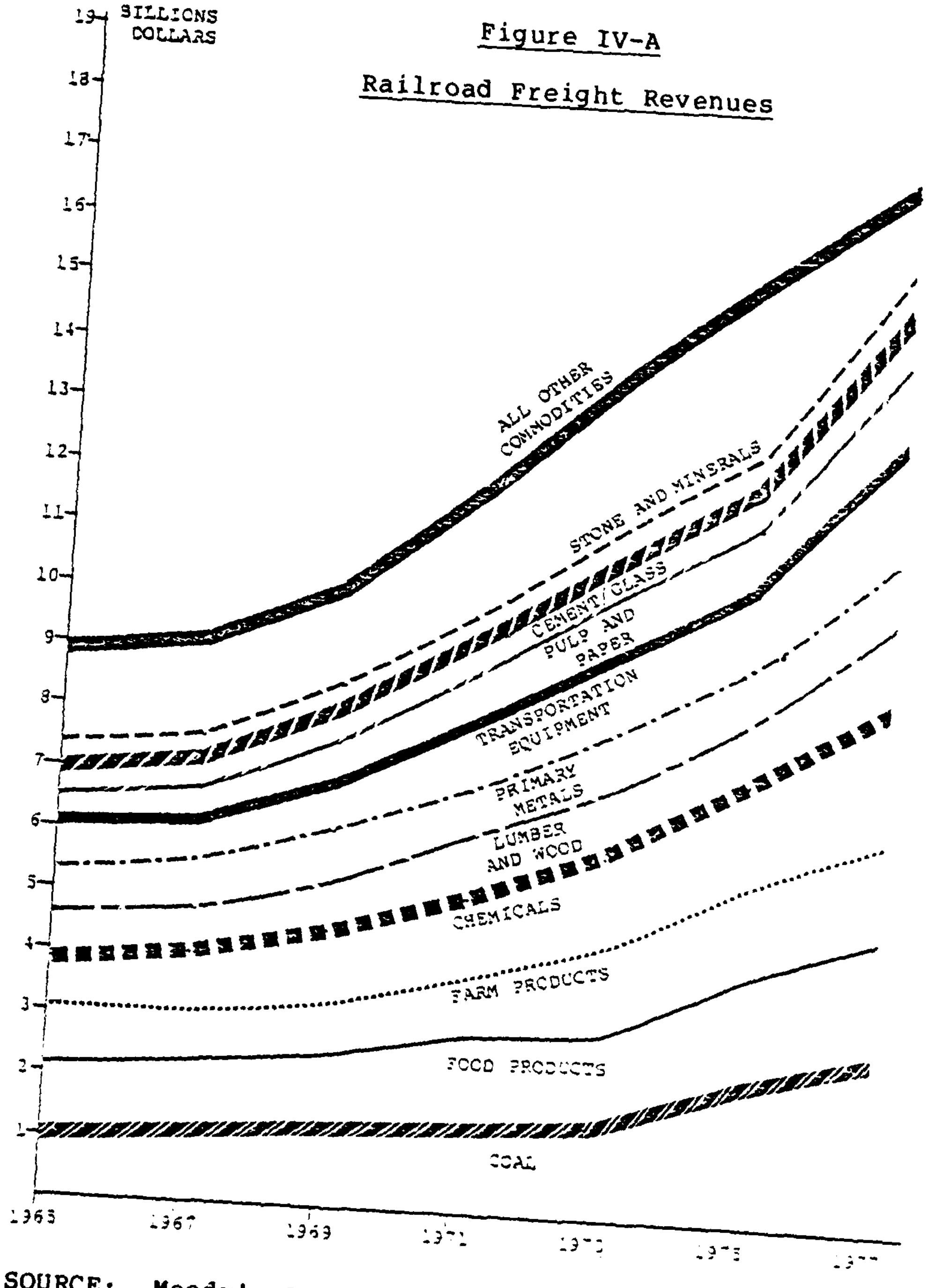
The railroad industry's traffic mix is skewed even more heavily toward bulk commodities based on tonnage handled; see Table IV-5. The differences in ranking and relative importance of commodities on a revenue versus tonnage basis are related to railroad rate structures. Many commodities move in large volumes but are of a lesser importance because of the lower level of rates and/or shorter hauls. The "stone and minerals" category ranks second on a tonnage basis, but only tenth as a source of revenue.

It is anticipated that this trend will continue in the future, with increased railroad emphasis on the movement of bulk or other commodities which move in relatively large volumes between a limited number of shipping/receiving points. This tends to minimize single car shipments, which are costly for the railroads to handle.

Any significant efforts by the railroads to continue to handle the higher valued and/or smaller volume shipments is likely to involve the use of TOFC or COFC. A good example of such service is the mini-bridge or land bridge service. This service involves the transport by dedicated train of high-valued cargo in containers or

Figure IV-A

Railroad Freight Revenues



SOURCE: Moody's Transportation Manual, 1975.

Table IV-5

Commodities Transported by Rail
(1977 Tonnage)

Commodity	Tons (000)	Percent of Total Commodity Tonnage	Revenue ($ 000,000)	Percent of Total Commodity Revenue
Coal	414,869.6	29.7	2,698.5	13.9
Stone and Minerals	139,580.1	10.0	686.7	3.5
Farm Products	121,878.9	8.7	1,484.0	7.7
Chemicals	104,267.8	7.5	2,212.0	11.4
Lumber and Wood Products	99,263.5	7.1	1,415.6	7.3
Food Products	95,707.3	6.9	2,040.7	10.5
Metallic Ores	83,195.2	6.0	446.8	2.3
Cement/Glass	59,905.3	4.3	822.3	4.2
Primary Metals	55,155.1	4.0	957.3	4.9
Pulp and Paper	44,911.9	3.2	1,212.3	6.3
All Other	176,007.6	12.6	5,417.5	27.9
TOTAL	1,394,742.3	100.0%	$19,393.7	100.0%

SOURCE: Moody's Transportation Manual, 1979.

trailers loaded on flatcars. Service is provided to and from coastal ports in order to bypass more circuitous vessel routings. In the future, the railroads will offer improved piggyback service over a much broader area than is presently available. This change may enhance the railroads' competitive position vis-a-vis motor carriers, on both a cost and service basis. There should be minimal impact on waterborne carriers and on pipelines.

FINANCIAL CONSIDERATIONS

The profitability of the railroad industry is extremely low, with a number of carriers consistently posting losses. This pattern of deficit operations has forced such roads as the Boston and Maine, the Rock Island, and the Milwaukee Road into bankruptcy and reorganization. Many factors have been identified by various analysts as contributing to the financial condition of the industry, such as labor productivity and the structure of the industry, for example. During the decade of the 70's federal action was taken to relieve two contributory factors, namely the burden of intercity passenger transportation and many of the economic regulatory restraints.

(a) Industry Performance

In 1978 the industry's rate of return on net investment was an unattractive 1.62%, the fourth consecutive year of a return less than two percent. The rate of return for the industry has not exceeded three percent since 1966; see Table IV-6.

The traffic base and regional economic growth and activity are significant factors in the level of profitability of the carriers. Table IV-6 shows a substantially better performance for the Southern and Western carriers, a trend that corresponds with the shifts in rail revenue previously identified.

The railroads' financial situation is partially the result of an inability to increase prices as rapidly as cost inflation; see Figure IV-B.

(b) Capital Requirements

As a result of the industry's financial condition, plant and equipment have deteriorated. It is estimated that deferred maintenance over the ten-year period from 1969 to 1978 amounted to $5.4 billion. Cash flow from internal operations, together with funds that can be raised from the private financial markets, are generally insufficient to meet capital needs. The result has been a deterioration in the reliability of rail service, causing the railroads to be even less competitive.

Table IV-6

Railroad Rate of Return on Net Investment
(In Percent)

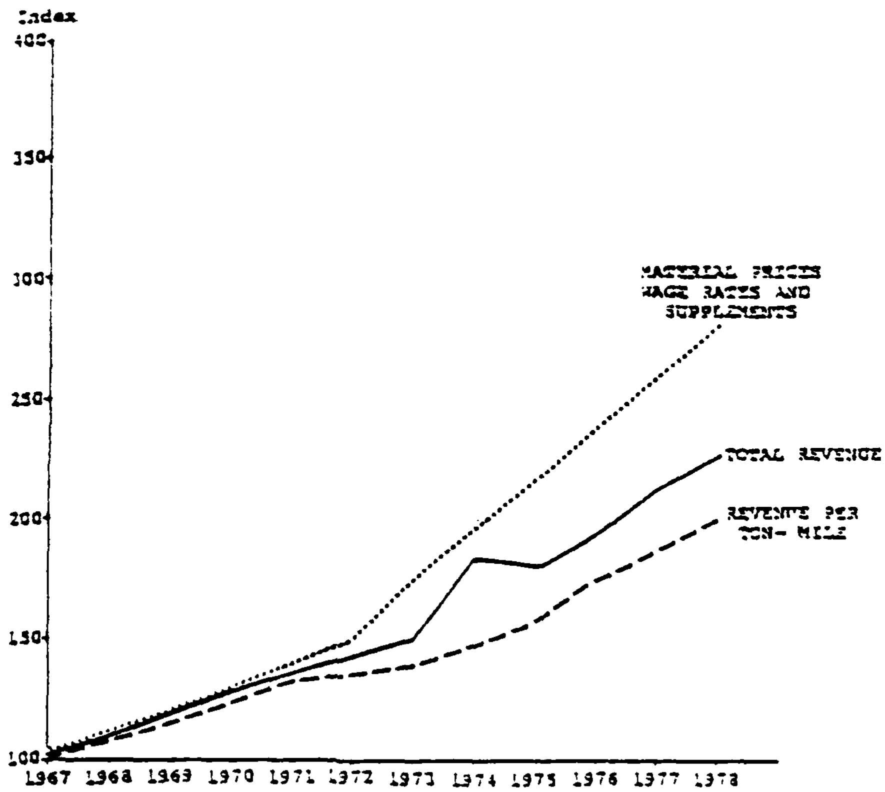
Year	Total	Eastern District	Southern District	Western District
1964	3.16%	2.56%	4.01%	3.43%
1965	3.69	3.32	4.16	3.87
1966	3.90	3.55	4.45	4.03
1967	2.46	1.58	3.86	2.75
1968	2.44	1.27	3.79	3.01
1969	2.36	1.10	4.17	2.81
1970	1.73	Deficit	4.50	3.02
1971	2.12	Deficit	4.36	3.51
1972	2.34	0.11	4.61	3.34
1973	2.33	0.07	4.61	3.30
1974	2.70	0.46	4.73	3.66
1975	1.20	Deficit	3.98	2.65
1976	1.60	Deficit	4.63	3.57
1977	1.60	Deficit	5.23	3.71
1978	1.62	Deficit	5.44	4.40

SOURCE: Association of American Railroads, Yearbook of Railroad Facts, 1979.

The future does not appear to be promising. The Department of Transportation estimates that railroad capital requirements will amount to $42.5 billion between 1976 and 1985. During the same period of time, the

Figure IV-B

Revenue and Cost Trends - Class I Railroads - 1967-1978

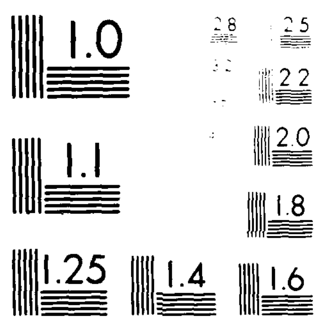


SOURCE: Railway Age, January 28, 1980.

AD-A107 366 KEARNEY (A T) INC CHICAGO ILL F/G 15/5
NATIONAL WATERWAYS STUDY OVERVIEW OF THE TRANSPORTATION INDUSTR--ETC(U)
AUG 81 V CHURCHWARD, E ISELY DACW72-79-C-0003

UNCLASSIFIED NL

2 OF 3
AD A
107366



1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

railroads are expected to be able to generate only $29.5 billion (Table IV-7). The $13 billion short-fall will prevent the necessary capital expenditures to enable the industry to compete effectively with other modes. This could result in a further deterioration in rail market share.

Table IV-7

Railroad Capital Requirements/Sources of Funds 1976-1985
(Billions of Dollars)

Capital Requirements	
Expenditures for Road Property	$ 6.8
Expenditures for Equipment	21.5
Capital Needed to Repay Debt	10.7
Capital Needed to Improve Working Capital, Etc.	3.5
TOTAL	$42.5
Sources of Funds	
Cash Flow from Operations (after dividends)	$10.1
Proceeds from Equipment Financing	16.8
Proceeds from Sale of Debt	1.7
Other Sources	.9
TOTAL	$29.5

SOURCE: United States Department of Transportation, *A Prospectus for Change in the Freight Railroad Industry*, 1978.

FINANCIAL ASSISTANCE

The 4-R Act provided funds for railroad maintenance and improvement projects, as well as acquisition, rehabilitation, and improvement of rail facilities and equipment. This assistance consists of two types: preferred stock loans and loan guarantees. The initial applications for this assistance have totaled in excess of $1.2 billion, although not all applications have been

approved. Approvals have generally been for equipment and facilities that are deemed to be part of the permanent rail system of the United States.

It is anticipated that the government will continue through this decade to assist the railroads in meeting some portion of their capital requirements for maintaining and improving the rail system. This capital assistance may amount to $5 billion. In addition, considerable funding may flow into the railroad industry through assistance to Conrail and the financially week Midwest carriers.

While federal programs will not cover all projected deficits, the operating rail carriers will be made more competitive with other modes. Concurrently, the rationalization of the rail system will be assisted through the withholding of funds for maintenance or improving of facilities that are not of a long-term significance.

EQUIPMENT/OPERATIONS

(a) Railcars

There are some 1.6 million railcars available to handle commodity traffic; see Table IV-8. Although this represents a decline in the past 15 years, it does not necessarily reflect a decrease in the capacity for handling freight. Such capacity in terms of tonnage ratings has actually shown an increase of 22 million tons, or 22.1%. Larger cars are being purchased to replace the older cars that are being retired, with 50-ton capacity boxcars replaced by cars having 70- or 100-ton capacities. Similarly, 70-ton hoppers are being replaced by cars with 100-ton capacity.

The trend toward larger railcars has been significant in the improved efficiency of rail operations. The costly operations of handling cars in yards and switching industries have been significantly reduced on a per ton basis because of the larger cars. This also explains, in part, the shift in emphasis to large shippers with bulk-type commodities. A 100 ton covered hopper car cost about

Table IV-8

Railcars Owned by United States Railroads, Car Companies, and Shippers

Year	Railcars	Average Capacity per Car (Tons)	Total Capacity (000 Tons)
1964	1,796,264	58.3	104,722
1965	1,800,662	59.7	107,500
1966	1,826,499	61.4	112,147
1967	1,822,381	63.4	115,539
1968	1,800,375	64.3	115,764
1969	1,791,736	65.8	117,896
1970	1,784,181	67.1	119,719
1971	1,762,135	68.4	120,530
1972	1,716,937	69.6	119,499
1973	1,710,659	70.5	120,601
1974	1,720,573	71.6	123,193
1975	1,723,605	72.9	125,651
1976	1,699,027	73.8	125,388
1977	1,666,533	75.5	125,823
1978	1,652,774	76.7	126,768

SOURCES: American Railway Car Institutes Official Railway Equipment Registers; and Association of American Railroads.

$47,000 in 1980 and an open hopper car cost about $44,000 in the same period. A jumbo tank car capable of carrying 23,000 gallons cost $55,000 in 1980.

(b) Specialized Equipment

Besides the purchase of larger cars, the type of cars being acquired differs from those being retired. Various types of specialized equipment have been in service, suitable for handling a limited number of commodities or, in some cases, shipments for a limited number of shippers. An example would be the tie-down system on tri-level cars for handling automobile shipments. The system is tailored to each manufacturer's automobiles and, for the most part, remains in the exclusive service of that shipper.

The plain unequipped boxcar was historically the primary car in the railroad fleet. It was versatile, in that it could handle a variety of manufactured, packaged, and bulk commodities. In 1978, the number of plain boxcars declined by 17,381 units. This capacity loss was only partially offset by the purchase of larger unequipped boxcars. To a considerable extent, the capacity was replaced by specialized boxcars equipped with load retaining devices and other special equipment, or by covered hoppers for handling bulk commodities. This is another indication of the railroads' strategy of serving the larger, frequent shipper.

The trend toward specialized equipment offers both advantage and disadvantages for the carriers. The advantage relates to the likelihood that the control of highly specialized cars will be easier. Disadvantages relate to the carriers' inability to utilize the equipment in other service if the traffic for which the equipment was purchased should decline, and to the inherent deadheading as the car moves back to its origin empty. This cost of under utilization of equipment must then be borne by the shipper using the car.

(c) Equipment Utilization

Although part of the problem of utilization relates to specialized cars, a key issue is the timely movement of all cars. The average freight car moved only 59.5 miles per day in 1978 (Table IV-9), or 21,718 miles per year. By comparison, an over-the-road truck will average at least 100,000 miles annually, and even a slow moving barge may attain 20,000 miles per year or more. The average for railcars has increased by 19% since 1964, but even this small improvement is somewhat misleading. The most significant increase has occurred in the Western District where, in recent years, there has been a large number of coal unit trains added to the fleet to generate substantially more miles than the national average.

The industry's lack of railcar utilization is not a problem of over-the-road speed, even though freight trains moved at an average speed of only 19.3 miles per hour in

1978. The real problem is that the typical serviceable railcar spent only 13% of its time in road trains, loaded or empty. The remainder of the time was spent in loading/unloading, movement within a terminal and in yards, or in idleness because of seasonality. Improvements in these areas will reduce future capital requirements and improve present profit levels.

(d) Locomotives

The other major equipment investment is the motive power to move freight. In 1978, there were 27,772 locomotive units in service on the Class I railroads in the United States. The number of units in service since 1968 has remained fairly constant (Table IV-10). Older locomotives are being replaced by units with substantially more horsepower. This trend has resulted in an aggregate horsepower improvement, from 49.2 million in 1968 to approximately 61.2 million in 1978, an increase of 24.4%. A representative cost for a new 3,500 horsepower linehaul locomotive in 1980 was $781,000.

Table IV-9

Average Daily Railcar Mileage

Year	United States	Eastern District	Southern District	Western District
1964	50.0	41.1	45.4	61.3
1965	51.7	42.7	47.1	63.2
1966	53.0	42.8	49.5	64.9
1967	51.5	42.2	48.1	62.5
1968	53.5	41.6	52.2	66.6
1969	54.9	41.6	54.5	69.2
1970	54.6	41.2	51.2	70.4
1971	53.3	39.7	49.2	68.8
1972	56.1	41.3	52.1	72.2
1973	57.7	41.9	53.4	74.6
1974	57.4	41.9	54.2	73.4
1975	53.5	40.2	49.6	66.9
1976	56.6	41.1	51.9	72.3
1977	58.0	40.5	52.6	75.5
1978	59.5	39.7	55.5	76.7

SOURCE: Association of American Railroads.

Table IV-10

Locomotives in Service

Year	Number
1968	27,376
1969	27,033
1970	27,086
1971	27,189
1972	27,364
1973	27,800
1974	28,084
1975	28,210
1976	27,609
1977	27,667
1978	27,772

SOURCE: Association of American Railroads.

(e) Train Size

As noted previously, the railroads are using larger cars with heavier loads to improve productivity. A related method of productivity improvement has been the running of heavier and longer trains, which tends to spread fixed and labor-related costs over more revenue freight per train. Table IV-11 shows that the average train in 1978 carried 2,029 tons as compared with 1,618 tons 15 years earlier, an increase of 25.4%.

ECONOMIC REGULATION

Economic regulation of the railroads began in 1887 with the Act to Regulate Commerce. The Interstate Commerce Commission was created in an effort to control or eliminate a number of abuses that were competitive and/or economic in nature. The railroads became the first major transportation mode to be required to operate within an environment in which many of the ground rules were established and monitored by a government regulatory body.

Table IV-11

Train Operations

Year	Cars per Train	Average Tons per Train
1964	69.7	1,618
1965	69.6	1,685
1966	69.3	1,715
1967	70.5	1,740
1968	70.1	1,768
1969	70.0	1,804
1970	70.0	1,820
1971	67.9	1,751
1972	67.1	1,774
1973	66.6	1,844
1974	65.5	1,875
1975	68.6	1,938
1976	67.1	1,954
1977	67.2	2,029
1978	67.1	2,029

NOTE: Train length has also increased because of the use of longer cars.

SOURCE: Association of American Railroads.

The regulation of the railroad industry is concerned with eight basic areas:

1. Review of rates and establishment of tariff filing procedures.

2. Control of entry and exit from markets.

3. Approval of mergers and consolidations.

4. Settlement of disputes regarding the division of revenue between carriers.

5. Enforcement of the common carrier obligation.

6. Sanctioning of collective ratemaking (rate bureaus).

7. Establishment of rules and procedures concerning finance and accounting matters.

8. Restrictions against ownership of carriers of other transportation modes.

Critics of the regulatory environment, including carriers, many shippers, and some public agencies, state that present industry problems can be traced to the government efforts to regulate an industry which is no longer engaged in *de facto* restraint of trade. A number of symptoms are postulated as being partially or wholly the result of regulation. These include:

1. Little pricing innovation.

2. Excess protection of shippers.

3. Inefficient equipment distribution.

4. Substantial excess trackage.

5. Limited merger activity.

6. Poor equipment utilization.

7. Disputes concerning the equitable division of revenue.

8. Deteriorating service.

9. Low profit levels.

It should be noted that other critics state that the regulatory environment is not entirely responsible, and that the lack of aggressive and progressive management has also played a significant role.

Pressures for regulatory change grew as the financial health of the rail industry deteriorated. The 4-R Act introduced a new era in railroad regulation, as revised ground rules were established for the control or review by the ICC of ratemaking, mergers, abandonments, and collective ratemaking (rate bureaus).

The Act attempted to encourage creative rail marketing and pricing through new procedures for peak and seasonal rates, separate rates for distinct (separate) services, and rates to encourage transportation packages which involve substantial capital investments by shippers and/or carriers. The goal became the maintenance of regulation only where sufficient competitive forces did not exist.

The framework for regulatory change was identified only in broad terms in the 4-R Act. The specific details and the procedures were to be established by the ICC. Because of the radical departure from the historical type of rail regulation, the ICC initially took a fairly conservative approach at implementing some of the key provisions, especially those relating to ratemaking freedom. This approach was coupled with an equally conservative approach by the railroads, which resulted in very limited use of the freedoms granted under a relaxed regulatory environment.

Continued poor financial results were then posted by the railroads, and change in the regulatory environment was offered as a solution. A new climate then began to emerge as the result of the ICC's more liberal interpretation of the 4-R Act. Rate suspensions and investigations declined, and experimental peak and seasonal rates were approved even though there were substantial shipper protests. The approval of the concept of contract rates, previously illegal because of ICC rulings, occurred in 1979.

With the deregulation programs in the airline industry proving to be politically acceptable, the popularity of the theme of railroad as well as motor carrier deregulation also increased. A number of proposals were put forth ranging from a nearly complete deregulation of economic restrictions, to minor adjustments of the present procedures. Any changes would increase the opportunity of railroad management to more effectively compete in the marketplace, increase revenues, and restructure assets.

The rail deregulation issue is still unsettled. When legislative changes are made, they will most likely meet a basic set of objectives on which most of the interested parties agree.

These appear to be as follows:

1. The preservation of a private enterprise rail system in the United States is essential, and is dependent on the achievement of more realistic levels of revenue in the industry.

2. Rail carriers must be allowed to exit from markets where competitive conditions or cost factors make profitable service impossible.

3. Competition should be substituted for regulation wherever it will provide a reasonable level of shipper protection.

4. Where regulatory procedures are applied, they must be practical in terms of data requirements and the cost of preparation.

5. Wherever shipper impacts are likely to be severe (but unavoidable if the railroads are to become profitable), a time-phased approach should be applied.

The railroads are beginning to take advantage of the relaxed regulatory environment. Any other legislative/administrative changes will further enhance the position of the railroads, through increased revenue, increased market share, and/or reduced operating costs. In some cases shippers will experience increased rates and reduced service. In other cases modal competition will be impacted as the railroads become financially stronger and more competitive. This is particularly true if end-to-end rail mergers and acquisitions are successful. In that situation rails would be in an improved position to compete with barges for coal and grain traffic.

PRICING

Complex rail rate interrelationships exist between areas of the country, as well as between competing products. In some cases the structures are the result of industry pressures, with major shippers pushing for an equitable scale of rates for their industry. In other cases, the evolution of the regulatory process resulted from rates being prescribed by the ICC as a remedy to complaints alleging discrimination.

There has been very little price competition among rail carriers. For the most part, each carrier who participates in the handling of a piece of traffic charges the same rate as other carriers. Any changes in rates are made by all carriers at the same time.

This lack of price competition is the result of the railroad rate bureaus. The rate bureaus allow the joint establishment of rates by the railroads. Although each carrier has the right to establish its own rates, the action of the rate bureaus (by joint vote of the participating carriers) is the usual means of establishing or changing rates.

In many cases, rate changes are made very slowly and are not always innovative in their approach. A major part of the difficulty is related to getting a number of carriers to agree. While the rate bureaus offer the carriers some degree of protection from intramodal competition, they have hindered the carriers in meeting competition from other modes. Even though a carrier could take independent action, most appeared to be reluctant to do so on a large scale.

The future increase in rate freedoms noted previously will be accompanied by a reduction in the protection that the rate bureaus offer through collective ratemaking. Some proposals even go so far as abolishing the rate bureaus except as a tariff publishing entity. At the same time, individual rate adjustments will be made with increasing regularity, partly as the result of competitive actions by carriers. The most significant reason is the ICC's stance that general rate increases should not be the major instrument for covering cost increases, as has previously been the case.

As a result, historical rate relationships will change, with some shippers being placed at a competitive disadvantage. This will force changes in the markets and producing areas of industries that rely heavily on rail. Competitive modes will be impacted as rail carriers make individual adjustments more quickly and with much greater frequency. The railroads may become more competitive, especially in markets where the competing modes adjust the rates often, such as the shipment of grain by barge or truck.

MARKETING

The railroad industry has lagged far behind other industries in recognizing the importance of a strong marketing effort. Historically, railroad management has been concerned with the efficient operations of the trains. In other words, the operating department was the important force within the company. In many railroad organizations, schedules and operations were designed for maximum efficiency, without careful consideration to the needs of the shippers or the competitive advantage of carriers of other modes. Where competition was considered, it was that of competing railroads and not competing modes.

As the railroads became aware of the idea of marketing, many did not know how to market their product effectively or how to use the skills of marketing professionals. Where marketing departments were created, they lacked the authority to become involved in the decision-making process.

The situation has been changing slowly, with some carriers developing strong marketing efforts. There is a desire on their part to determine the transportation needs of major shippers, and to develop service and pricing packages to meet those needs. Efforts are being made to understand the markets and the total cost of using rail versus another mode, rather than basing decisions strictly on a comparison of the published transportation charges.

An important aspect of any rail carrier's marketing efforts is the availability of railcars. Demand for railcars is a derived demand and rises and falls with the economy as well as with seasonal fluctuations of any one industry's shipments. Accordingly the overall supply of railcars may fall short of demand (and additional car orders are placed by carriers and shippers) or may exceed demand (and railcars are stored on sidings until demand moves up in line with supply).

Car supply by railroads differ by both carrier and commodity. Generally, well financed carriers prefer to supply their own equipment to shippers. The Santa Fe's and Union Pacific's policies with regard to covered

hopper cars are good examples. However in the case of open top hoppers for coal service, the number of cars needed is so large for such carriers as the Burlington Northern that utilities have as a rule purchased their own cars.

Specialized equipment is also generally purchased by shippers. This equipment includes all tankcars and specially designed covered hopper cars for shipment of plastic products. The insurance, liability, repair, and maintenance problems associated with tankcars have resulted in a very high percentage of shipper-owned cars.

Boxcars, historically the car of the railroads, have been associated with low-rated traffic and erratic, single car movements. Accordingly, there was little incentive to invest in such equipment without incentive per diem payments. With the abolition of such payments, there is once again little incentive for carriers to invest in boxcars.

There are likely to be significant future marketing efforts by the railroads. The most important tool for the carriers will be increasing use of contract rates to specify not only the rate level, but also the service level and the equipment availability. The railroads will be working with large shippers to design a desirable contract rate package. This will cause traffic to be non-competitive for the term of the contract, and, therefore, not available to other railroads or the carriers of other modes.

RAILROAD TECHNOLOGY

The most significant changes in rail technology occurred some 25 years ago with the industry's conversion to diesel-electric locomotives from the steam powered equipment used previously. Since that time, the most significant trend has been toward the building of more powerful locomotives. This has allowed the railroads to handle effectively longer trains of greater tonnage, and has in turn led to improvements in car design. As explained previously, these two factors have been of prime significance in improving rail productivity.

These methods of improving productivity are approaching the level at which further meaningful gains are not likely. Train lengths and weights have reached the point where reliability is affected, because of the added stress and the increased number of components which can fail. The limits on the size of cars have approached the maximum that the present rail trackage system can sustain: generally, a maximum of 263,000 pounds, with the effective load limit at approximately 100 tons per car. The railroads, expecially some Western carriers moving unit coal trains, are watching the trackage maintenance situation closely, and are renegotiating rates where necessary.

Line capacity has not generally been a constraint for the railroads, except for some heavily traveled sections. Additional volume can be accomplished where necessary through the upgrading of signaling and/or the addition of sidings. The construction of additional trackage can also substantially increase capacity (see Table IV-12).

Technological improvements now impacting direct operations represent more of a refinement than a broad change. The one area of significance is improvement in the fuel efficiency of locomotives. With the price of diesel fuel continuing to increase, these efficiencies become a significant factor in reducing operating costs. Electro-Motive Division units (SD40-2 and GP40-2) achieve annual fuel savings of up to 13,200 gallons over older locomotives. General Electric is also making improvements in the fuel efficiency of its units with savings of up to 7.2%, or 27,400 gallons per year. Older units are also being improved as newer technology is being applied during rebuilding. As the result, fuel usage in 1978 was 1.1% less than 1974, but represented an increase of 7.1 billion ton-miles of freight.

As identified earlier, one of the industry's major problems relates to the under-utilization of its rolling stock. With railcars costing $40,000 to $50,000 or more and moving only an average of 59.5 miles per day, improved equipment utilization offers substantial opportunities. To accomplish this, the railroads are making increased use of computers to schedule loaded cars on specific trains.

Table IV-12

Railroad Linehaul Capacity

Route Type	Average Speed	Train Hours	Number of Trains Per Day
Railroads: (100-mile district) Single-Track (theoretical)			
10 Sidings	10 mph	240	24
	20 mph	240	48
	40 mph	240	96
20 Sidings	10 mph	480	48
	20 mph	480	96
	40 mph	480	192
Single-Track (practical)			20-30
(potential)			40-50
(Centralized Traffic Control - practical)			45-60
(Centralized Traffic Control - potential)			80-100
Double-Track (theoretical)			80-100
1-Mile Train Length,	20 mph	2,400	480
2-Train Headway	40 mph	2,400	960
1-Mile Block,	20 mph	1,600	320
3-Block Headway	40 mph	1,600	640
Double-Track (practical)			
Manual or Automatic Block (practical)			60-80
Manual or Automatic Block (potential)			
Centralized Traffic Control			160-200
Four-Track (practical)			300-360
(potential)			360-460

SOURCE: William H. Hay, An Introduction to Transportation Engineering, John Wiley, 1961.

Of perhaps greater importance, railroads are monitoring empty cars to permit the computer to stage the equipment to meet shipper needs, with a minimum of time delay and movement to the next load.

NON-ECONOMIC REGULATION

This topic deals with the impact of non-economic regulation on the railroad industry. While the discussion revolves around environmental and safety issues, the purpose is not to describe the environmental aspects of the industry. This was done in the Element M Report (Analysis of Environmental Aspects of Waterways Navigation). Rather, this discussion focuses on the "feedback" of regulation resulting from those aspects of the industry and the effects of those regulations on the industry.

One historic practice of the industry in performing right-of-way maintenance was to burn old ties along the right-of-way. Air quality restrictions in many (probably most) jurisdictions have forced the cessation of this practice. Consequently the railroads now incur additional costs to physically remove old ties from maintenance sites and dispose of them elsewhere.

The railroads also operate hundreds of fueling points throughout the system. Historically these operations were manually controlled and spills were frequent, with consequent adverse impact on soil conditions and water quality. Stricter enforcement of water quality has required the industry to make major changes in these operations. Collection pits have been constructed and automatic cutoffs installed on pumps, all at a greater cost with some savings of fuel.

Many issues of socio-economic and environmental impacts surround railroad operations in urban environments. Local government can impose speed limits on trains and restrict the amount of time that grade crossings can be closed to vehicular traffic. Where local jurisdictions choose to exercise these powers, railroad operations can be seriously affected through increased delays and costs.

Another concern surrounds noise. The primary sources of noise are the modern "hump" yards, which by their nature are noisier than traditional "flat" yards. The major mitigation effort undertaken by the industry is the installation of sound barriers, again at additional cost.

The most important concern about the industry is safety. There have been many spectacular derailments, often involving hazardous cargo, in recent years. This has led to two major regulatory thrusts at the federal level. The first of these is the classification of the entire system and the imposition of operational restrictions on unsafe trackage. This in turn imposes additional delays and costs on operations.

The second major federal thrust in this area was a once and for all requirement to modify all existing tank cars and to build new tank cars differently. All tank cars must now be equipped with Type F shelf couplers and tanks must be double walled. These modifications will not reduce the liklihood of derailment but are expected to reduce the likelihood of the release of the contents of tank cars in accidents. This campaign again imposed additional costs on the industry.

SUMMARY

The railroads have suffered a substantial decline in their share of the transportation markets. Competing modes have made significant inroads in the transportation of many products, especially those which are time sensitive (higher value). The product mix has become bulk commodities oriented, with substantial business from those large shippers of manufactured products whose shipping patterns are concentrated.

The railroads have been plagued by excess capacity as the result of years of over-expansion. Hindered by regulatory procedures, the economically mandated reduction of the system has come very slowly. Future reductions are expected, with the total rail system being much smaller.

The financial health of the rail industry has been well publicized. The low level of profitability has impacted the railroads' ability to make the capital improvements necessary to maintain an efficient transportation system. This has resulted in a deterioration of plant and equipment, which had directly affected the quality of service.

Projections of future capital needs indicate a significant cash shortfall. Because of this situation, the federal government has been assisting the carriers through 4-R Act provisions.

The railroads have improved the efficiency of rail operations by utilizing larger cars and more powerful locomotives capable of moving longer trains. Future improvements will be in two significant areas. The first is in the use of more fuel efficient locomotives. The second and more significant area is related to improvement in the utilization of equipment, through sophisticated computer scheduling.

The railroads, as an industry, have not been known for aggressive marketing. This is changing because of the acceptance of the marketing concept and the addition of skilled marketing personnel. With a relaxation of regulatory restrictions, these changes could result in the railroads assuming a more substantial position in the transportation marketplace. They now have the ability to establish long-term contract rates. This permits rail to compete more effectively for the high volume contract bulk traffic, especially coal and grain.

CLASS I RAILROADS

For statistical purposes, railroads are defined as either linehaul or switching and terminal companies by the Interstate Commerce Commission. They are also segregated into Class I (annual revenues of $50 million or more) and Class II (annual revenues less than $50 million). Class I linehaul railroads haul about 99% of the traffic, operate 94% of the mileage, and employ about 92% of railroad personnel.

ALPHABETICAL LIST OF CLASS I LINEHAUL RAILROADS IN UNITED STATES, MARCH 7, 1978

Alabama Great Southern R.R.
Atchison, Topeka & Santa Fe Ry.

Baltimore & Ohio R.R.
Bessemer & Lake Erie R.R.
Boston & Maine Corp.
Burlington Northern Inc.

Central of Georgia Ry.
Chesapeake & Ohio Ry.
Chicago & North Western Ry. System
Chicago, Milwaukee, St. Paul & Pacific R.R.
Chicago, Rock Island & Pacific R.R.
Cincinnati, New Orleans & Texas Pac. Ry.
Clinchfield R.R.
Colorado & Southern Ry.
Consolidated Rail Corp.

Delaware & Hudson Ry. Co.
Denver & Rio Grande Western R.R.
Detroit, Toledo & Ironton R.R.
Duluth, Winnipeg & Pacific Ry.

Elgin, Joliet & Eastern Ry.

Florida East Coast Ry.
Fort Worth & Denver Ry.

Grand Trunk Western R.R.

Illinois Central Gulf R.R.

CLASS I RAILROADS

ALPHABETICAL LIST OF CLASS I LINEHAUL RAILROADS IN UNITED STATES, MARCH 7, 1978 (Cont'd)

Kansas City Southern Ry.

Long Island R.R.
Louisville & Nashville R.R.

Maine Central R.R.
Michigan Interstate Ry. Co.
Missouri-Kansas-Texas R.R.
Missouri Pacific R.R.

Norfolk & Western Ry.

Pittsburgh & Lake Erie R.R.

St. Louis-San Francisco Ry.
St. Louis Southwestern Ry.
Seaboard Coast Line R.R.
Soo Line R.R.
Southern Pacific Transportation Co.
Southern Ry.

Union Pacific R.R.

Western Maryland Ry.
Western Pacific R.R.

ALPHABETICAL LIST OF CLASS I SWITCHING AND TERMINAL COMPANIES IN UNITED STATES, MARCH 7, 1978

Aliquippa & Southern R.R.
Alton & Southern R.R.

Baltimore & Ohio Chicago Terminal R.R.
Belt Ry. Co. of Chicago.
Birmington Southern R.R. Co.

Conemaugh & Block Lick R.R.
Cuyahoga Valley Ry. Co.

Houston Belt & Terminal Ry.

ALPHABETICAL LIST OF CLASS I SWITCHING AND
TERMINAL COMPANIES IN UNITED STATES, MARCH 7, 1978
(Cont'd)

Indiana Harbor Belt R.R.
Indianapolis Union Ry.

Kansas City Terminal Ry.
Kentucky & Indiana Terminal R.R.

Lake Terminal R.R. Co.
Lakefront Dock & R.R. Terminal Co.

Monogahela Connecting R.R.

Patapsco & Back Rivers R.R. Co.
Philadelphia, Bethleham & new England R.R.
Port Terminal R.R. Assn.

South Buffalo Ry. Co

Terminal R.R. Assn. of St. Louis

Union R.R. (of Penna.)

SOURCE: Moody's Transportation Manual, 1979

V - PIPELINES

Pipelines form a critical part of the transportation system of the United States. Over 200,000 miles of underground pipe carry an array of bulk commodities, ranging from wood chips and sugar cane to coal and natural gas. The domestic pipeline complex is important in our energy distribution system through the carriage of the bulk of our petroleum transport, with a potential role for coal slurry transportation.

The pipeline network has had a major influence on the nation's economic development and the allocation of resources. Petroleum pipelines, the chief component of the system, demonstrate these outcomes, as well as the operating characteristics and the competitive and regulatory structure characteristic of pipeline operations.

PETROLEUM PIPELINES

Pipelines carry more crude oil and refined petroleum products greater distances than any other domestic transportation mode. The table below shows market participation percentages by mode, total tonnage and ton-miles.

Table V-1

Petroleum Transportation Percentages by Mode, Tonnage and Ton-Miles

	1976 Percentage of Total	
	Tons	Ton-Miles
Pipeline	47.9%	59.7%
Marine	21.9	35.1
Motor Carrier	28.8	3.7
Railroad	1.4	1.5
TOTAL	100.0%	100.0%

SOURCE: Association of Oil Pipelines.

As can be seen in the table, pipelines accounted for nearly half the tonnage moved and almost sixty percent of the ton-miles of United States petroleum movement. In contrast, the railroads provided transport for only 1.5% in each category. Figure V-A shows the domestic petroleum pipeline network.

(a) Long-Haul versus Short-Haul

The most startling comparison in Table V-1 is the contrast between the percentage participation in the tonnage handled by motor carriers and their percentage participation in ton-mileage. This occurs because petroleum pipelines are essentially a long-haul mode, while tank trucks are used for short hauls only. To illustrate, petroleum products may be transported 900 miles from a southern Louisiana refinery to Chicago, while a tank truck may carry the product only 75 miles from the Chicago terminal to Rockford.

This dichotomy may be explained by the flexibility and costs of motor carriers. Pipelines handle large volumes economically, but can accept or deliver shipments only at points along the pipeline right-of-way. In contrast, a tanker truck is ideally suited for hauling small volumes of fuel from terminals to consuming areas, with the flexibility to adapt to changing usage profiles in terms of destination and volume.

This flexibility, however, comes at greater cost. While pipelines may be inflexible and expensive to construct, the cost per ton-mile approximates $.0025. In contrast, the cost per truck ton-mile is about $.04 - 16 times as much.

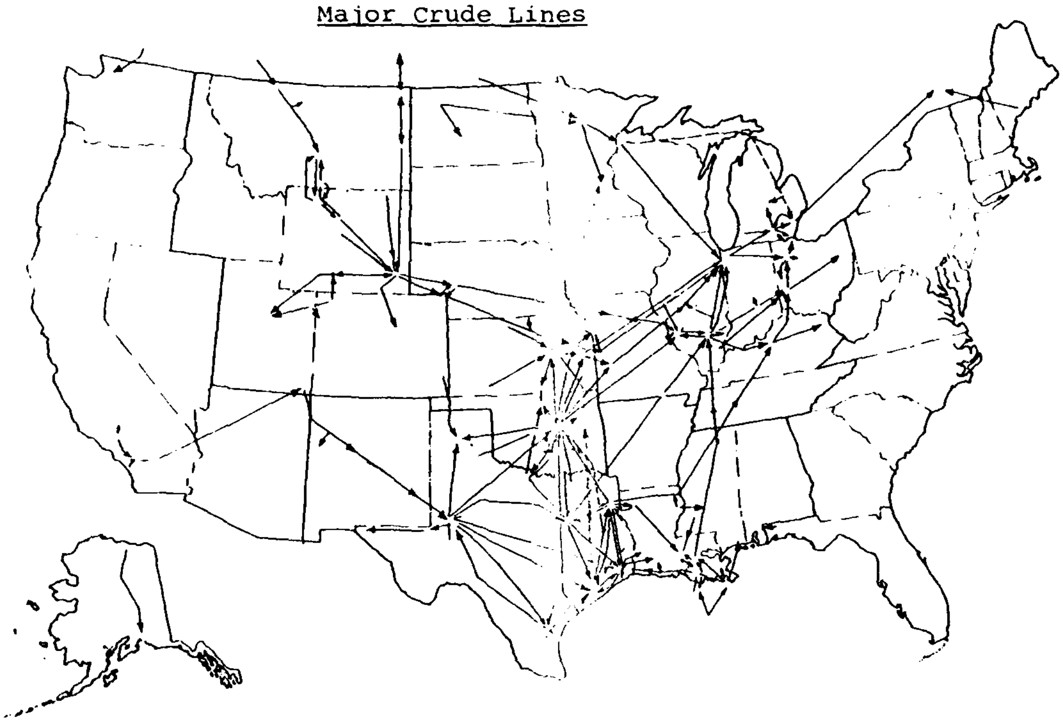
(b) Shifts in Mode Share

Table V-2 presents information on the modal share of petroleum products shipments from 1938 to 1976. As can be seen, dramatic shifts have taken place. The technological advancements in pipelines coupled with the completion of

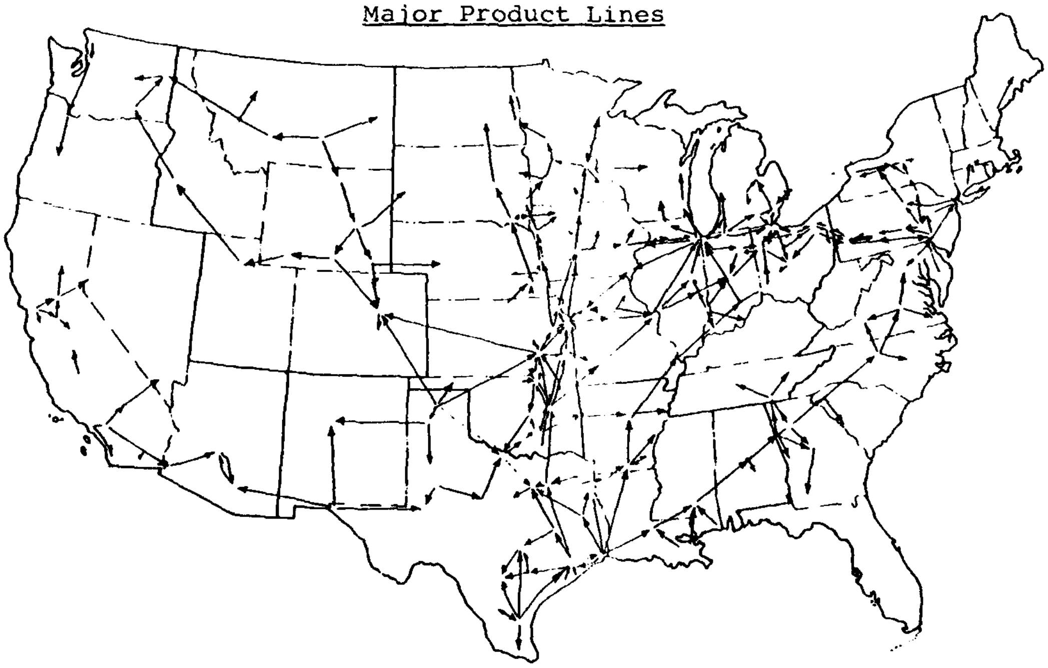
Figure V-A

Major Crude Oil and Product Pipelines

Major Crude Lines



Major Product Lines



SOURCE: National Petroleum Council

the National highway system resulted in a shift of traffic to a long-haul pipe movement of products with final delivery by truck.

Table V-2

Shifts in Petroleum Transportation
Modal Share of Traffic in Tons (Percent)

Year	Pipeline	Water Carriers	Motor Carriers	Rail
1938	6.35%	52.65%	10.59%	30.41%
1943	8.39	36.42	29.44	25.75
1948	11.36	44.70	29.85	14.09
1953	15.59	41.76	34.09	8.56
1958	20.48	37.51	36.76	5.25
1963	23.25	34.67	38.52	3.56
1968	30.41	25.69	41.35	2.55
1977	32.74	25.78	39.31	2.17
1974	33.54	25.84	38.45	2.17
1975	34.82	26.73	36.43	2.02
1976	35.58	26.17	36.41	1.83

SOURCE: Exhibit V-1.

As of 1977, petroleum pipelines accounted for the following mileages:

Crude Oil Trunk Lines	77,972
Crude Oil Gathering Lines	67,798
Product Trunk Line	81,296
Total Miles	227,066

Technological advancements made in the 1930s allowed significant welding improvements, to virtually eliminate leakage at pipe joints when light products, such as gasoline and kerosene, were carried. Advancements in the manufacture of pipe permitted larger diameter, seamless pipe, facilitating large increases in throughput and reducing per barrel cost.

Although rail transport of bulk liquids is more cost effective than trucking, pipelines retain a very significant economic advantage even relative to rail. Pipeline transport costs are the lowest for any overland carrier. Truck rates are in the range of \$.50 to \$.75 per 100 barrel-miles. The equivalent rail cost range is \$.10 to \$.60, the barge range is \$.05 to \$.17, while the pipeline cost range is 4.02 to \$.12. Even though barge costs overlap the pipeline range, the inherent limitations of the inland waterways system restrict the extent of direct competition. Marine serves those markets not accessible to pipeline provides service for product demand greater than pipeline capacity.

(c) Regulation

Pipelines are subject to regulation by various governmental agencies. Pumping stations and construction sites are policed by OSHA. EPA environmental impact statements must be filed on federally financed pipeline construction and oil industry consortiums must be cognizant of the impact of antitrust laws. The most influential regulatory requirement, however, is financial/economic.

The regulation of pipeline investment risk/reward has long been the responsibility of the ICC. The ICC was given the authority to regulate interstate pipelines in the Hepburn Act of 1906; more recently the regulatory roles has been transferred to the FERC, Federal Energy Regulatory Commission.

Two important regulatory principles were established by the ICC in the 1940s. First, the commission ruled that pipeline companies be limited to a maximum of eight percent rate of return on crude lines and ten percent on product lines. Second, a consent decree was signed at that time limiting payments to the stockholders of shipper-owned pipelines to a maximum of seven percent return on the previous year's book value.

An outcome of the rate of return maximum on pipeline investment is an absence of independently owned petroleum pipelines. Over 85% of the United States crude oil line

mileage, and more than 70% of the product line mileage, are owned by domestic refiners.

Because of the reduced incentive to take entrepreneural risk, only oil companies in such joint ventures as the Explorer Pipeline have been willing to invest the huge sums of capital necessary for construction. The consortium's incentive is in the opportunity for vertical integration and not profitability of the venture *per se*.

(d) Expansion Plans for Petroleum Pipelines

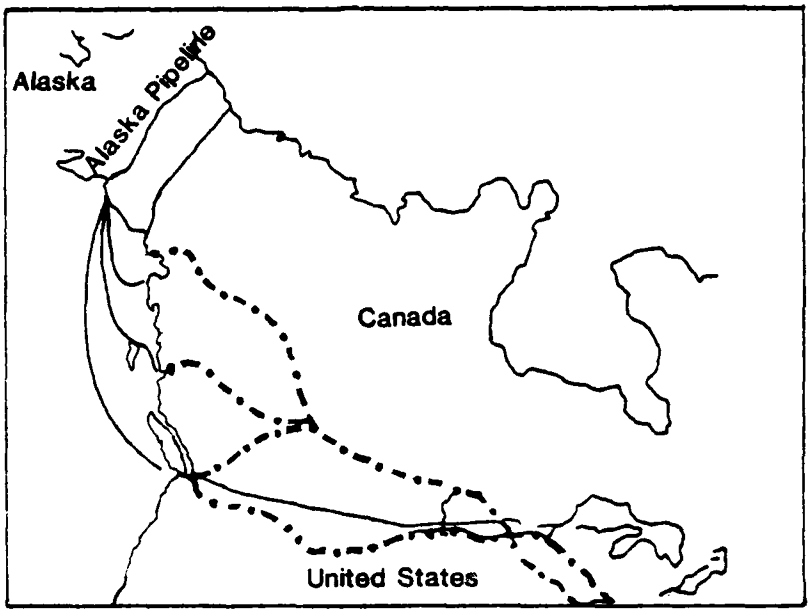
Future pipeline construction and expansion are likely to be far greater than suggested by the volume growth of two to four percent expected annually by the petroleum industry over the coming ten years. As an example, the United States Congress is expected to approve the construction of a pipeline to carry Alaskan crude oil from the West Coast to the Midwest beginning about 1982.

Refineries located in Illinois, Wisconsin, Indiana, Michigan and other northern tier states are operating at less than full capacity due to crude oil shortages. The traditional source of crude for these refineries has been Canada, which has reduced its exports to conserve oil for internal use.

Currently, there are four different pipeline proposals, each designed to reduce the surplus of crude on the West Coast and to partially meet the demand for crude oil in the northern tier and inland states. Figure V-B shows the proposed oil lines of the Northern Tier Pipeline Company, Northwest Energy Company, Kitimat Pipe Line Ltd., and Trans Mountain Oil Pipe Line Corporation.

Figure V-B

Proposed Crude Oil Pipelines



SOURCE: United States Department of the Interior.

1. Northern Tier Pipeline Company's proposal is an "All American" system, which would use a 1,491-mile pipeline running from Port Angeles, Washington, to an area just north of Minneapolis. The cost of the proposal would be $1.2 billion, with an estimated completion date of late 1982. The ultimate capacity of the pipeline would be one million barrels a day.

2. Northwest Energy Company's proposal would transload oil from tankers to a storage terminal at Skagway, Alaska, and then through 14 miles of pipeline in Alaska and 696 miles on main line in Canada. The pipeline would connect to existing Canadian pipelines in Alberta. Costs are estimated at $919 million, and the project can be completed in two years with a capacity of up to 750,000 barrels per day.

3. Kitimat Pipe Line's proposal is an all-Canadian system where the crude would first be pumped from tankers at Kitimat, British Columbia. From there, the crude would move via a 716-mile new pipeline to Edmonton, Alberta, where the remainder of the routing would be through pipelines presently in place. The cost is estimated at $850 million, with completion in two years after Canadian government permits are issued. This system would deliver 500,000 barrels of crude daily.

4. Trans Mountain Oil Pipe Line Corporation's proposal accepts oil at Low Point, Washington, and then moves it via a new pipeline north to Edmonton, where it will connect with an in-place system. This project would cost $525 million and deliver 630,000 barrels per day.

When economics permit, expansion of existing capacity has often been an option of the pipeline industry. The Colonial Pipeline Company demonstrated that in-place pipeline improvements can expand capacity. Colonial has undertaken six major expansions, costing over $815 million and resulting in a tripling capacity to 2,300,000 barrels per day; see Table V-3.

COAL SLURRY PIPELINES

Recent prices of oil and natural gas have increased dramatically, and there has been growing uncertainty over their availability. Nuclear development is also uncertain, due to safety and uranium supply constraints. Government support appears to be increasing for the use of coal in supplying future power requirements.

Consequently, growth in annual United States coal consumption is expected to triple to two billion tons by the year 2000. Emission standards on coal have forced many utilities to burn low sulfur, low BTU coal, which is produced in Montana and Wyoming. This coal typically yields less than one percent sulfur content and has a heat content of between 8,000 to 10,000 BTUs per pound.

Some of the proposed pipelines plan to participate in the transportation of Western coal to consumption areas located in the Midwest and Southwest, distances of 1,000

Table V-3

Colonial Pipeline Expansion

System of Major Expansions		Capacity after Expansion (Bbls. per Day)	Expressed as Percent of 1965 Capacity	Capital Investment ($ Millions)
Initial System				
1963 to 1963	Main Line 8 miles 32".	792,000		$ 363.7
Major Expansions				
1966	Additional lines and stations.	960,000	121%	14.6
1967	Additional machinery on main line.	1,092,000	137%	18.5
1968	Additional machinery on main line.	1,152,000	145%	7.1
1971	Additional lines and stations.	1,440,000	182%	116.0
1976	Additional lines and stations.	1,800,000	227%	136.7
1978	Additional lines and stations.	2,100,000	265%	309.5 (1)
1979	Additional lines and stations.	2,300,000	290%	213.2 (1)
	Total Major Expansions		290%	815.6
Other Improvements and Additions				47.5
	Total Investment in System			$1,225.8

NOTE: (1) Estimated total project costs. Construction schedules require portions of these expenditures to be carried over to subsequent years.

SOURCE: Colonial Pipeline: Performance and Trends, December 1978.

to 1,600 miles. There are, however, a number of issues which challenge the feasibility of coal transportation by pipeline. In addition, there is the possibility of pipeline construction for the transportation of synthetic fuel produced at mines.

(a) Water Availability

Slurry pipelines depend on an adequate water supply for normal functioning. The water component of the coal slurry mix is about 50% by weight, or about a ton of water per ton of coal. While Eastern slurry pipelines would have an adequate water supply, Western slurry pipelines may face a water shortage. Thus, proponents of the latter group of lines have come under severe criticism.

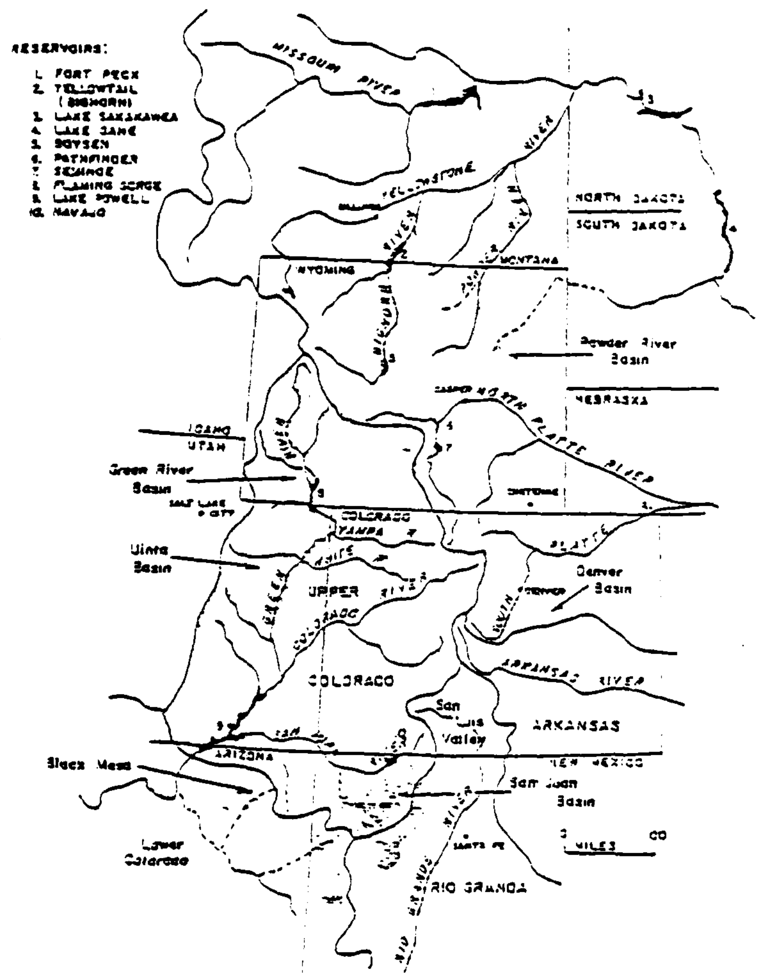
Water supply is a critical political issue in the Rocky Mountain states, where a large portion of the coal reserves are located. This is reflected in a struggle for water rights between the current users of Western water, primarily for agricultural interests, and industrial promoters, such as pipeline operators.

Figure V-C shows the surface and ground water availability for the six coal-producing areas. The Governor of Wyoming has vetoed a $1.8 billion pipeline project, claiming that Wyoming needs its water resources. Another proposed pipeline from Utah to California, which was intended for export coal movements, was blocked by conservationists who are also interested in protecting water resources. Montana's legislature has precluded the use of water for slurry pipelines. As a consequence, if Montana coal is to be moved in a slurry pipeline, the water used must be brought in from another state.

Although it is generally agreed that enough water is physically available to serve existing uses and provide sufficient volume for proposed pipelines, the physical availability of water must be distinguished from the legal

Figure V-C

Water Availability for Six Coal-Producing Areas



SOURCE: A Technological Assessment of Coal Slurry Pipelines, March 1978.

availability. The right to use water is very difficult to obtain in Western states for the following reasons:

1. Water rights have been reserved through Indian rights, interstate compacts, and the limited quantity available at any given location.

2. Some states prohibit the exportation of water, while Wyoming requires special legislative permission.

3. Some states wish to protect agricultural interests over industrial development.

4. Recently, water rights have been granted for use only when water is not scarce.

5. In some areas, applications for water use already exceed present supplies.

A positive aspect of water use for slurry pipelines is the fact that pipelines can use saline, brackish, and other low-quality water unsuitable for other purposes. Some saline water might be available to pipelines through water quality improvement programs. Estimates of the available saline water are between 57,000 to 135,000 acre-feet per year.

(b) Environmental Concerns

There are some concerns over pollution problems of coal slurry water. The EPA has the following concerns over slurry water:

1. Which pollutants are absorbed?

2. Can pollutants be treated?

3. What effect will pollutants have if discharged into the rivers and streams?

Recent EPA studies have identified pollutants which remain in slurry water. While adequate technology exists to treat the water, the EPA also recognized the need for additional work in this area.

Laws and regulations will be forthcoming to adequately control the amount of any polluting elements which might be discharged into rivers and streams. The pollution problem of slurry water may well be minimized ultimately, because the water may be reused at power generating stations.

(c) Eminent Domain Legislation

Passage of liberal eminent domain legislation would benefit coal slurry pipeline developers. Four proposed pipelines, the Alton Pipeline, ETSI, Houston Natural Gas Pipeline, and Texas Eastern Transmission Pipeline, may be built without eminent domain. Other pipelines, such as the Florida Pipeline and Pacific Bulk Commodity Transportation System, require eminent domain legislation for their implementation.

(d) Need for Slurry Pipelines

Coal slurry advocates see pipelines as providing expanded transportation capabilities and competition to railroads at a reduced cost. Utilities have expressed concern over recent rail rate increases, claiming that recent increases make it more economical to burn oil rather than coal. Utilities want more transportation competition in long-haul coal moves.

The railroad industry has stated that if slurry pipelines come into being, they would take away the more profitable high volume traffic. The fear is that the loss of this business would dramatically increase their costs of operation on a per ton basis. The net result might be increased rates on coal to other utilities.

Many sources agree that the present rail system does have the ability to handle coal tonnage increases in the

foreseeable future. For example, in January 1978, a Department of Transportation study concluded that:

> "In general the Nation's transportation system is handling current coal volumes without significant problems. Between now and 1985, the foreseeable problems in coal transport can be solved, if monitored closely and acted on in a timely fashion. Beyond 1985, the situation is less clear, although with the lead times for transportation investment decisions being generally shorter than those for new coal mines or coal using facilities, transportation capacity should not be a constraint."

(e) Financial Concerns

There are concerns over the ability of the slurry pipelines to obtain long-term debt financing commitments on reasonable terms from private investors. The institutional investment community perceives slurry line ventures as particularly risky for a number of reasons, including:

1. The possibility of a pipeline shutdown caused by an inadequate water supply, strikes, sabotage, or poor management.

2. Failure to achieve maximum throughput.

3. Increased rate competition from railroads.

4. Changes in national energy policies.

While financing risks will not disappear, they might well diminish with the demonstrated operation of a coal slurry pipeline.

COAL SLURRY SYSTEMS

Although there are problems with new slurry line construction, several successful systems are already in use or are proposed. Each pipeline discussed in this section

is numbered and corresponds to the numbers in Figure V-D on the following page.

(a) Consolidation Coal Ohio Pipeline (1)

This 108-mile long pipeline was built in 1957 to operate between the Consolidated Coal Company mine at Cadiz, Ohio, and the East Lake Power System in Cleveland. This line, with a capacity of 1.25 million tons per year, was built in response to rail rate increases and operated until 1963. As a competitive response, the railroad reduced its rate low enough to justify taking the pipeline out of service.

(b) Black Mesa Pipeline (2)

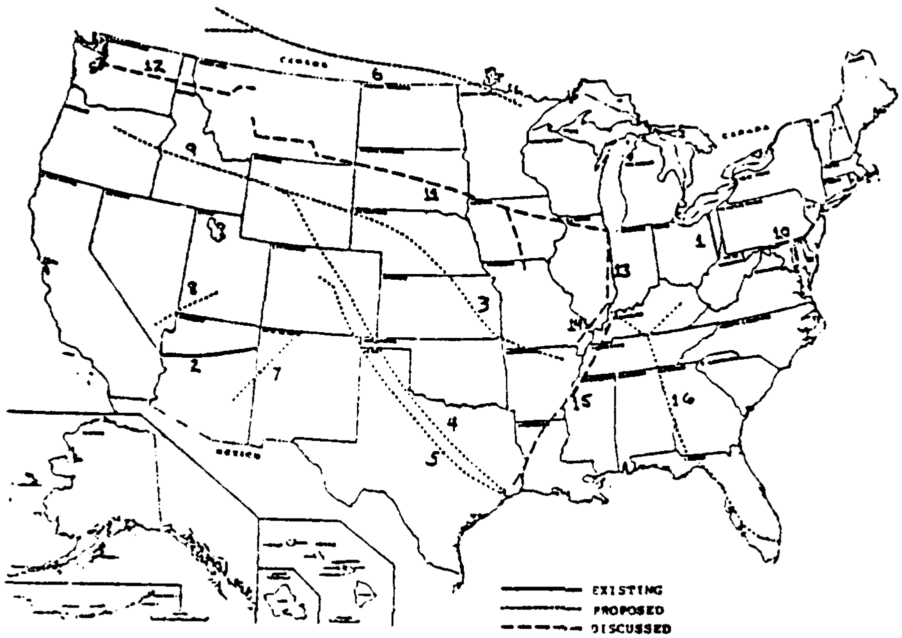
The Black Mesa Pipeline is the only domestic operating pipeline. It connects Peabody strip mines in Kayenta, Arizona, to the Mohave Power Plant in southern Nevada. This 273-mile long pipeline was built because it was considered more economical than the building of 150 miles of new rail trackage. This line has an annual capacity of 4.8 million tons and takes about three days to deliver coal.

(c) Energy Transportation Systems, Inc. (ETSI) (3)

The ETSI proposal plans to deliver 25 million tons of Western coal annually from Gillette, Wyoming, to White bluff, Arkansas. Estimated cost for building the 1,036-mile long pipeline was given at $750 million in 1975; this figure did not include water supply, right-of-way, preparation plant and dewatering facilities. The estimated completion date is 1983.

Figure V-D

Coal Slurry Pipeline



SOURCE: A Technology Assessment of Coal Slurry Pipelines, March 1973.

(d) Texas Eastern Transmission Pipeline (4)

Brown and Root Inc. has proposed this pipeline originating in the Powder River area at the Wyoming-Montana border, and terminating at Houston, Texas. This 1,260-mile long pipeline would have a throughput of 26 million tons of coal a year with an estimated completion of 1985.

(e) Houston Natural Gas Pipeline (5)

This proposed pipeline would annually ship 15 million tons of both bituminous and subbituminous coals from Colorado and New Mexico to plants in Texas, primarily Houston. Approximately ten million tons of coal would first move by rail from Colorado origins to a central location. Water will be supplied from Alamosa, Colorado, to slurry coal from New Mexico to Colorado. In Colorado, this coal will be mixed with other coal for the final destination in Texas. The estimated completion date is 1983.

(f) Canadian Transport Commission (6)

The Canadian Transport Commission conducted a study to examine the costs of pipeline versus unit train for coal originating in Edmonton, Alberta, to Lake Superior, where the coal would be transloaded for final delivery by lake barge. This pipeline would be approximately 1,200 miles long and carry from 10 to 20 million tons per year.

(g) Arizona Public Service Co. Pipeline (7)

This 200-mile pipeline would transport less than 10 million tons annually from Star Lake, New Mexico, to St. Johns, Arizona.

(h) Alton Pipeline (8)

This 175-mile pipeline would transport 10 million tons annually from Alton, Utah, to St. George, Utah. The estimated completion of the pipeline is 1984.

(i) Gulf Interstate - Northwest Pipeline (9)

This 1,100-mile pipeline would run from Gillette, Wyoming, to power plants around Boardman, Oregon. The line

was estimated to cost $700 million in 1976. An annual capacity of 10 million tons is expected.

(j) Fairmont, West Virginia - Staten Island, New York Pipeline (10)

A study by the Office of Coal Research analyzed the possibility of moving coal by slurry pipeline 355 miles from Fairmont, West Virginia, to Staten Island, New York. The pipeline's capacity would be 2.6 million tons per year. The study concluded that the costs, especially for acquiring rights-of-way, would be too high to justify constructing the pipeline.

(k) Montana to Chicago and St. Louis (11); Montana to Washington State (12)

The Bureau of Mines undertook two pipeline studies concerning the movement of Montana coal to Chicago, St. Louis and the State of Washington. No further development efforts have been undertaken for these pipelines.

(l) Southern Illinois to Chicago; to Arkansas; and to Texas (13, 14, 15)

These three pipelines have also been studied to determine the cost feasibility. At this time there are no further plans for construction.

(m) Florida Pipeline (16)

Several Southeastern utilities are studying the feasibility of building a 1,500-mile coal slurry pipeline from eastern Kentucky to southern Florida. The construction of this pipeline would require the passage of eminent domain

legislation. With timely passage, operations could begin as soon as 1986. No capacity estimates have been given at this time.

It should be noted, however that mine-mouth steam plants using transmission of electricity by wire are an alternative to coal-slurry pipelines.

HIGHLY VOLATILE CHEMICALS

Pipelines represent the single most important transport mode for propane, one member of a volatile chemical family which includes liquid natural gas, butane, and anhydrous ammonia. Table V-4 shows the barrel-mile modal distribution for propane.

Table V-4

Propane Transportation - 1974

	Barrels per Day	Average Miles per Barrel	Thousands of Barrel-Miles per Day: Number	Thousands of Barrel-Miles per Day: Percent
Truck	602,900	122	73,260	16.6%
Pipeline	1,053,900	318	335,030	76.0
Rail	88,800	276	24,530	5.6
Barge	11,000	746	8,220	1.9
Total Barrels Handled (1)	1,756,686	251	441,030	100.0%
United States Total Production (approximate)	1,300,000	339	441,030	100.0%

NOTE: (1) Includes double counting for shipments traveling by more than one transport mode.

SOURCE: McClanahan Consultants, Inc., for the National LP Gas Association.

Pipelines, in connection with truck and rail modes, accounted for over 75% of propane transported, measured in barrels per day. This trend of pipeline dominance is seen as continuing into the future.

The major issue concerning pipeline use for highly volatile chemicals is the safety regulations governing their movement. At the present time, there are a variety of safety regulation proposals concerning valve spacing and operation requirements. The pipeline industry objects to these requirements on the basis that the costs of compliance may more than offset any potential benefits, and possibly divert traffic to rail or water.

EXHIBIT V-1

SHIFTS IN PETROLEUM TRANSPORTATION

Year	Total Petroleum Products Carried	Pipelines(1) Tons Carried	Pipelines(1) Percent of Total	Water Carriers Tons Carried	Water Carriers Percent of Total	Motor Carriers(2) Tons Carried	Motor Carriers(2) Percent of Total	Railroads Tons Carried	Railroads Percent of Total
1938	173,911,713	11,045,962	6.35%	92,555,200	52.65%	10,423,060	10.59%	52,887,493	30.41%
1943	233,[illegible]03,200	19,556,43	8.39	84,865,592	36.42	60,596,500	29.44	59,984,665	25.75
1948	363,282,510	41,254,281	11.36	162,390,189	44.70	108,447,800	29.85	51,190,248	14.09
1953	485,834,799	75,762,935	15.59	202,890,739	41.76	165,612,789	34.09	41,568,336	8.56
1958	615,006,000	125,968,566	20.40	230,690,771	37.51	226,071,342	36.76	32,275,321	5.25
1963	727,919,323	169,272,168	23.25	252,376,335	34.67	280,393,430	38.52	25,077,390	3.56
1968	988,583,300	300,606,600	30.41	253,992,300	25.69	408,000,000	41.35	25,184,400	2.55
1970	1,070,460,000	333,085,000	31.12	286,367,000	26.75	425,200,000	39.72	25,816,000	2.41
1971	1,103,555,900	346,810,800	31.43	302,071,300	27.37	429,900,000	38.96	24,773,800	2.24
1972	1,199,710,500	388,641,400	32.39	322,930,400	26.92	462,500,000	38.55	25,638,700	2.14
1973	1,282,527,200	419,827,600	32.74	330,687,300	25.78	504,177,000	39.31	27,835,300	2.17
1974	1,253,462,500	420,375,600	33.54	323,860,200	25.84	481,993,000	38.45	27,225,700	2.17
1975	1,219,899,100	424,759,300	34.82	326,077,900	26.73	444,398,000	36.43	24,663,900	2.02
1976	1,336,604,000	475,600,300	35.58	349,947,400	26.17	486,615,700	36.41	24,440,600(1) (P)	1.83

NOTES: (1) Products pipelines move only light petroleum products - gasoline, heating and fuel oils, liquid petroleum gas, kerosene and jet fuel.
(2) The amounts carried by motor carriers are estimates.
(P) Preliminary.

SOURCE: Association of Oil Pipelines.

VI - MOTOR CARRIERS

INTRODUCTION

This report profiles the motor carriers industry in the United States. Table VI-1 highlights the relationship between various modes of transport and the national economy.

Table VI-1

United States Estimated Freight Bill, 1977

	Millions of Dollars	Percent Total
Motor Carrier	$134,842	78.3%
Air	2,357	1.4
Rail	19,581	11.4
Water	9,882	5.7
Other Carriers	3,448	2.0
Shippers Cost (1)	2,041	1.2
Total	$172,151	100.0%

Gross National Product (GNP) $1,887,200
Total Freight Expenditures as a Percent of GNP 9.12%

NOTE: (1) Includes loading and unloading of freight cars as well as operation of.

SOURCE: Transportation Facts and Trends (15th edition), Transportation Association of America, 1979.

Prior to 1935, anyone with sufficient capital to purchase a truck could become a motor carrier. In that year, those involved in interstate commerce were brought under the jurisdiction of the Interstate Commerce Commission (ICC) by passage of the Motor Carrier Act. This law, and additional legislation passed prior to 1977, placed significant restrictions on the industry.

1. Entry into the motor carrier industry required approval of the ICC.

2. Entry approval was time consuming and expensive, but transferable; therefore, operational authority became a valuable asset.

3. Rate bureaus were exempted from antitrust laws.

4. Carriers could discuss rates among themselves and, with ICC approval, set rates limited by competitive pressures.

5. Contract carriers were limited to approximately eight major shippers.

6. The majority of mergers and acquisitions were subjected to ICC approval.

Motor carriers have experienced tremendous growth since World War II, largely at the expense of the railroads. Table VI-2 shows the expansion of a major segment of the industry. It is interesting to note that the number of carriers has declined overall since 1960, primarily since numerous regional carriers have merged.

Table VI-2

Growth of the Motor Carrier Industry

Class I and II

Year	Millions of Dollars: Operating Revenues	Millions of Dollars: Operating Expenses	Number of Carriers
1945	$ 924.6	$ 916.7	1,894
1950	2,503.5	2,335.6	1,934
1955	4,404.2	4,226.6	2,765
1960	6,169.0	6,014.9	3,202
1965	9,034.8	8,582.9	3,673
1970	12,837.1	12,384.4	3,413
1975	19,164.7	18,342.1	2,688
1976	22,164.6	21,114.6	2,252
1977	26,240.6	24,901.0	2,464

SOURCE: American Trucking Trends, 1977-1978. American Trucking Association, 1979.

Flexibility is a major characteristic of truck transportation. Limited only by the highway network, motor carriers can deliver almost any commodity to any location in any quantity. Trucks complement other modes, providing initial gathering or final distribution of products for movement by rail, air, or water. The truck is economically viable in smaller operating units than is the railroad, which depends on long trains to achieve operational efficiency.

Overall costs in trucking are substantially higher than rail and water; however, motor carrier markets have been successfully developed due to several factors.

- Faster service.
- Localized delivery.
- Efficient handling of small shipments.
- Service orientation.

It should be noted that motor carrier services have developed despite the constraint of highway weight restrictions that have limited cargo to relatively small payloads.

In addition to providing substantial economic impact, motor carriers are significant direct and indirect employers as indicated in Table VI-3.

Table VI-3

United States Employment in Transportation, 1978
(In Thousands)

	United States Total	Trucking
Services	2,516	1,181
Equipment Manufacturing	2,064	1,103
Related Industries	5,204	1,307

SOURCE: Transportation Facts and Trends, Transportation Association of America, 1979.

INDUSTRY STRUCTURE OPERATION CHARACTERISTICS

The structure of the trucking industry has two major groupings, private and "for-hire". Private carriers transport their own materials and products in their own trucks. These carriers do not charge a market price for their service, and therefore, are exempt from federal (ICC) and state economic regulation. Important characteristics of these carriers are:

1. Is a captive transport arm of a producer or retailer.

2. Was formed due to the shipper's inability to secure needed service from public transport, desire for lower costs, or a combination of both factors.

3. Primarily handles truckload shipments.

4. Permits more effective control of schedules.

5. May concentrate on loads overpriced by public carriers.

6. Can provide tailored equipment when required.

For-hire carriers transport freight belonging to others. Most interstate carriers are regulated by the ICC and, where applicable to intrastate or local commerce, by the appropriate state or local regulatory commission. As a group, for-hire carriers provide more than one-half of all United States motor carrier production. Further distinction may be drawn from three classes of for-hire truckers.

- Regulated common carrier.

- Regulated contract carrier.

- Exempt commodity carrier.

The majority of for-hire carriers is composed of regulated companies. These may be either common carriers, who must provide their service to all shippers (the so-called "common carrier obligation"), or contract carriers, who are restricted to servicing a limited number of shippers. The remaining unregulated carriers handle commodities exempted from economic regulation, primarily unprocessed agricultural, livestock, or forest products. Any motor carrier may haul these commodities without economic constraint, regardless of the major thrust of overall operations. Private carriers may utilize those products as backhaul freight, an effective cost cutting technique if logistics and equipment permit.

Characteristics of the motor carrier industry are summarized in Exhibit VI-1. Regardless of economic regulation, all trucking firms and individuals are subject to applicable federal, state, and local safety, taxation, and statutory restraints.

EQUIPMENT
CHARACTERISTICS

Equipment varies widely according to carrier service commitment and geographic area. As shown in Table VI-4, single unit (straight) trucks are most common. Private fleet vehicles outnumber for-hire trucks 25 to 1. Both single unit and combination (tractor/trailer) provide transport for various commodities.

Table VI-5 summarizes the various types of load bodies, most of which are available as truck body or trailing equipment.

The use of trailers provides extra flexibility, since one power unit may be used interchangeably with several trailers. While engineering constraints and use may ultimately govern size, cargo boxes have tended to become longer and higher. Van trailers have considerable acceptance at 45' length and 13'6" overall height. Tank trailers have not tended to exceed 40' lengths since maximum payloads are possible within this size.

Table VI-4

Truck Vehicle Type and Use, 1977

	Number of Registrations	Percent of Total
Private Fleet		
Single Unit	26,509,614	93.6%
Combination	698,173	2.6
Subtotal	27,207,787	96.2%
"For-Hire" Fleet		
Single Unit	485,833	1.7%
Combination	618,333	2.1
Subtotal	1,104,166	3.8%
Total Fleet	28,311,953	100.0%

SOURCE: *American Trucking Trends, 1977-78, American Trucking Association, 1979.*

EXPENSE CHARACTERISTICS

Expense estimates are readily available only for regulated motor carriers. Table VI-6 indicates that among the most common expenditures, transportation, consisting of drivers' wages and fuel, are the highest. Private fleet costs are comparable, although terminal investment and traffic structure are somewhat lower.

DEREGULATION[8]

Serious problems and impressive opportunities confront today's motor carrier; therefore, a general understanding of the most critical issues is necessary. It is conceivable that future trucking industry characteristics may differ significantly from those described previously.

---

8 Deregulation discussion based on various scenarios developed by A. T. Kearney, Inc.

Table VI-5

Truck Body Type and Use

Type of Truck Bodies	Common Use
Van or box, Closed	General freight
Van or box, Open top	Machinery, freight requiring unloading from top or freight requiring excessive clearance
Flat	Steel, pipe, bulk building products
Dump	Bulk agricultural products, minerals, building materials, coal, soil, refuse
Tank, liquid	Bulk liquids
Depressed deck	Large machinery, construction equipment
Rack	Logs, pipe
Tank, pneumatic	Dry bulk
Refrigerated, box van or tank	Perishable products

Change will precipitate new strategies and priorities, and will require effective planning and response by industry, government, and the public sector.

Deregulation promises to bring changes of unknown proportion. Despite unified opposition from the trucking industry and its allied labor unions, deregulation (or regulatory reform) in some form appears to be likely. In fact, some change is now in effect.

1. Commercial zones (or areas of service surrounding towns and cities) have expanded.

Table VI-6

Sample Expenses of the Motor Carrier Industry
(As a Percent of Operating Revenues)

Operating Supplies and Expenses	100.0%
Rental/Purchase of Equipment	19.7
Operating Taxes and Licenses	14.5
Equipment Depreciation and Amortization	3.6
Insurance	3.0
Communications and Utilities	1.3
Other	7.9
Total	100.0%

SOURCE: *Trinc's Blue Book of Trucking Industry* (1979 edition).

2. Contract carriers are no longer limited to servicing a very small number of shippers which previously approximated eight (hence the widely used term "rule of eight").

3. The ICC is currently approving a significantly higher number of applications for operating authority (entry), with approvals generally broader in scope.

4. Dual operations, common and contract, may now be permitted over the same operating authority.

An appraisal of the economic consequence of deregulation is difficult, as there is little solid evidence to indicate its impact. It would have to be concluded that limited deregulation of the motor carrier industry is the most likely outcome. There are several reasons for this:

1. Major shipper organizations support at least partial change.

2. Trucking industrial associations and member carriers are cohesive in their opposition.

3. Trucking companies and labor wield sufficient political influence to prevent comprehensive deregulation.

If less than total deregulation occurs, probably the most significant change will be the entry of private fleet into common carriage. Intercorporate and for-hire operations will expand private fleet influence, and the truckload freight market will become highly competitive. If exempt carriers and others also enter the market, truckload rates will be depressed, vary more frequently, and to a greater degree. Quite possibly, some of these carriers might consider backhauls of bulk commodities less attractive than more lucrative general freight.

The influence of rail and water modes in these areas could increase substantially. There are certain outcomes from limited deregulation that are most probable:

1. Increased intercorporate hauling by private fleet.

2. Reduced enforcement of the "common carrier obligation".

3. Rate bureau power would be severely curtailed.

4. Truckload traffic would be deregulated, with lowered rates and increased competition.

5. Less-than-truckload rates would be regulated, but truckers would be empowered to vary charges within limits.

There will likely be various short- and long-term deregulation implications, not all of which will be immediately apparent as carriers readjust priorities and shuffle for position. A "limited deregulation" scenario is outlined in Exhibit VI-1 at the end of this section.

FUEL AND ENERGY ECONOMY

The question of fuel price and availability is one of major significance. Figure VI-A shows substantial recent increases in prices of both distillate fuel and gasoline. Prices will undoubtedly continue to rise, and adequate supply will continue to remain a function both of demand and international stability.

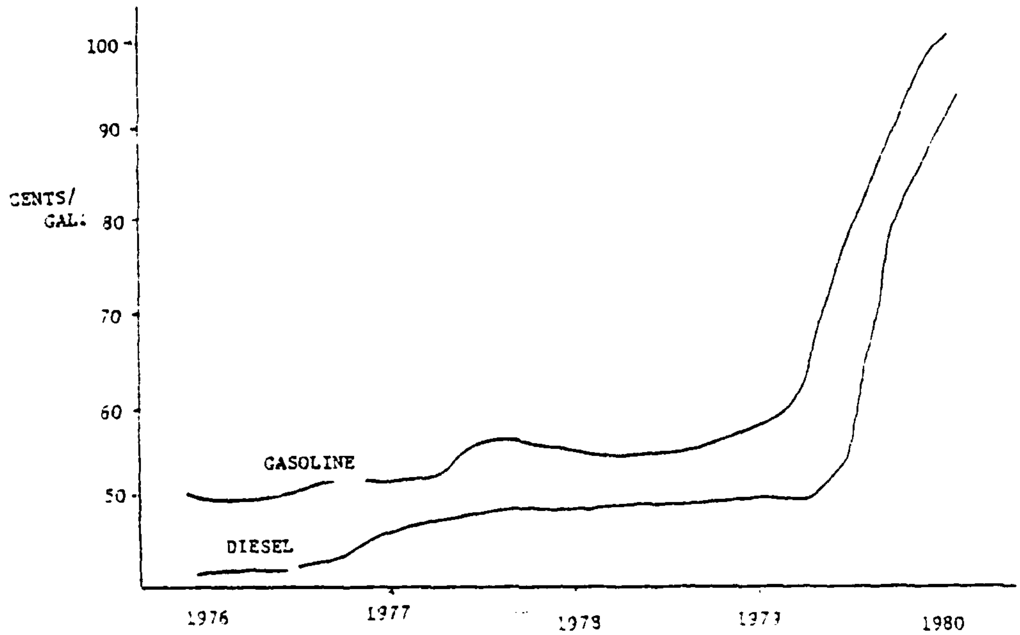
Table VI-7 shows the fuel consumption rates for several types of trucks. One example of new technology diesel engines is cited to show the impressive advances accomplished in engine design. Similar gains may be realized through use of weight conscious materials in truck body and cargo area engineering:

1. Aluminum to replace steel for doors and panels.

2. Fiberglass to replace steel fenders and hoods.

Figure VI-A

Prices of Retail Gasoline, Diesel Fuel



SOURCES: American Trucking Trends, American Trucking Association, 1979.
Basic Petroleum Data, Oil and Gas Journal, October 1979, National Petroleum Association.

3. Radial-ply tire construction.

4. Magnesium and aluminum alloys for load bearing members.

5. Alloy fuel and air tanks.

6. Plastic grills, trim, and interior panels.

SIZE AND WEIGHT CONSTRAINTS

Size and weight restrictions have been a subject of considerable debate in recent years. Since each state

Table VI-7

Average Truck Fuel Economy by Weight and Distance
(In Miles per Gallon)

	Gasoline	Diesel	New Technology Diesel
Medium Duty (10,000-19,500 pounds gross vehicle weight)			
Local	5.8-8.3	-	
Short Range	6.1-8.6	-	9.1-11.5
Long Range	6.1-8.6	-	
Light Heavy Duty (19,501-26,000 pounds gross vehicle weight)			
Local	5.7	6.8	
Short Range	5.7	7.0	8.7-10.5
Long Range	6 0	7.0	
Heavy Duty (26,001+ pounds gross vehicle weight)			
Local	4.9-5.3	5.7-6.0	
Short Range	4.9-5.3	5.7-6.0	6.0-7.5
Long Range	4.9-5.3	5.7-6.0	

SOURCES: Transportation Research Board, Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation, AASHTO, 1977.
Various publications, General Motors Corporation, 1978.

sets these limits independently, but within federal guidelines, both national and regional problems exist. The industry desires uniformity and liberalization.

Perhaps the most heated debate involves increased gross vehicle weights (GVW) and increased length laws. Advocates of these issues argue that higher GVW is necessary for continued profitability in view of increased costs, especially for fuel. Opponents argue liberalized

size-weight restrictions would hasten highway deterioration, a serious concern.

Increases in GVW would benefit the carrier of bulk commodities significantly, as these cargoes often reach maximum tonnage before volume is fully utilized. Size restraints would largely benefit the carrier of manufactured goods (less-than-truckload traffic), whose overall GVW is limited due to volume constraints. Some benefit would be realized for the bulk carrier if the use of tandem or double trailers (double bottoms) were universally accepted. In that way, payload could be spread over a greater distance or greater number of load bearing axles to reduce highway load factors.

INTERMODALISM

Intermodal opportunities are significant in the motor carrier industry. A truly responsive national transportation policy would certainly stress cost effective, energy conscious intermodalism. Yet, the concept remains a small contributor to our transport system.

1. Rail ownership of other modes, especially motor carriers, is restricted.

2. Surface carriers cannot participate directly in airline operation.

3. There are few intermodal joint rate tariffs.

4. Carrier self-interest is significant, often in ignorance of the cost savings opportunities in intermodalism.

5. Efficient utilization of fuel and equipment suffers when separate modal interests prevail.

6. Labor union opposition to intermodalism is significant.

7. Substitute rail service has never been attractive to motor carriers from either a cost or service standpoint.

Motor carriers have the greatest potential for intermodal development, especially where their portion of the haul is relatively short. Examples might be grain moving from elevators in a two- or three-state area to barge terminals on a major river; or coal trucked directly from mine mouth to rail terminal.

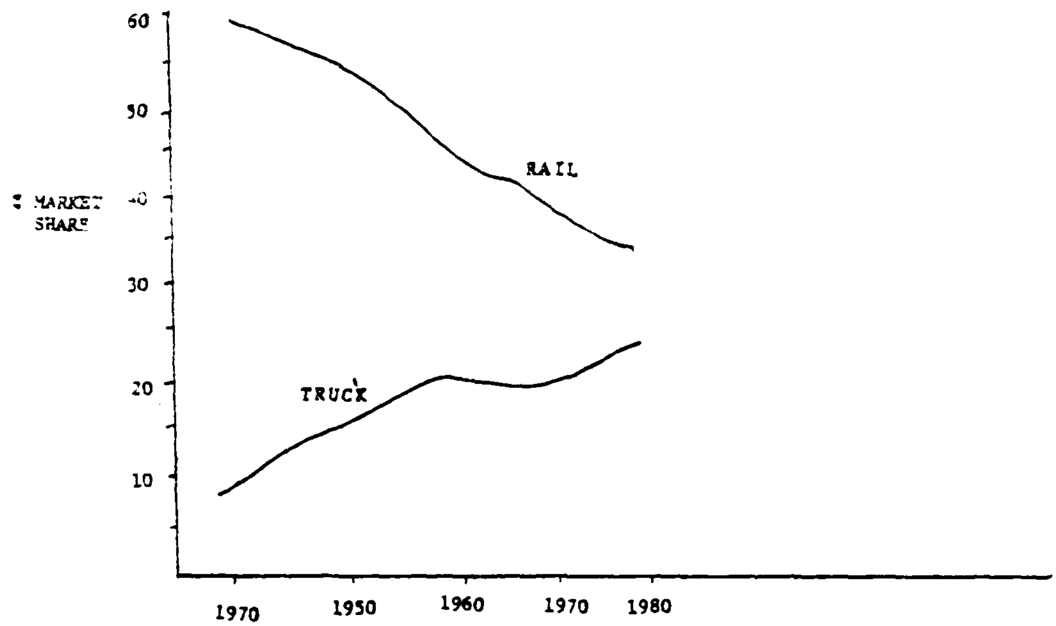
These types of movement could be impacted through intermodal truck movements since many terminals, especially waterborne, are low volume operations that cannot generate sufficient business to justify sophisticated material handling and storage technology. By providing feeder service from a wide area, motor carriers can interface with efficient consolidated terminals capable of utilizing new methods of cargo handling.

Motor trucks provide complementary service with other modes in many ways. Air freight is almost entirely dependent on truck for local pickup and delivery. Rail piggyback relies on motor carriers to feed their operations and often as a substitute for rail service at low volume points. The rail industry trend toward the closing of low volume piggyback facilities promises expansion of truck operations.

From a competitive standpoint, motor carriers' share of the transportaiton market grew largely at the expense of the railroads (Figure VI-B). Because the railroads have tended to charge high rates on high value items, motor carriers have been particularly successful in capturing movements of manufactured products, particularly due to the lower time in transit and resulting lower inventory costs. Rail piggyback poses a significant reverse threat to this very strategy, and may indeed cut into long-time trucker dominance. A significant portion of the movement of new automobiles is now on the railroads, and fresh fruit and vegetable transport is showing the beginning of a similar modal change due to exempt status. Both of the areas were at one time primarily truck markets.

Figure VI-B

Rail-Truck Share of Intercity Freight



SOURCES: D. Wycoff, Motor Carrier Industry, Lexington Books, 1977.
Transportation Facts and Trends, Transportation Association of America, 1979.

BULK COMMODITY MOVEMENT BY TRUCK

The trucking industry participates to a substantial extent in the movement of bulk commodities. Motor carriers are primarily used in short or medium distance bulk haul (less than 500 miles). By contrast, water and rail carriers have traditionally functioned most efficiently on long-haul movements (500 miles or more).

The precise scope of bulk motor carriage is difficult to define. There is little statistical information available on this segment of the trucking industry, since many of these materials are classified by the ICC as "exempt

commodities". These commodities are "exempted" from economic regulation and mandatory reporting.

Some examples of bulk materials commonly handled by motor carriers are:

- Agricultural products (partially exempt).
- Agricultural chemicals (not exempt).
- Coal (partially exempt).
- Forest products (not exempt).
- Primary metals (not exempt).
- Petroleum (not exempt).
- Chemicals (not exempt).

Table VI-8 indicates the motor carrier market share for selected bulk commodities. Statistics are not shown for agricultural products which are particularly exempt.[9]

COMPETITIVE MOVEMENTS

Motor carriers provide little direct competition to water and rail carriers in the movement of bulk commodities. Trucking companies continue to haul some bulk materials in selected traffic lanes that compete with the carriers. But this strategy is primarily used to contribute to fixed costs when backhaul general freight is not available. Similarly, some short- and medium-haul coal and grain movements have been captured by motor carriers at

---

9 Commodities and traffic are partially exempt from regulation if some jurisdictions exercise authority while others do not. The most important distinction is between Federal jurisdiction over interstate commerce and state jurisdiction over intrastate commerce.

Table VI-8

Shipment of Selected Bulk Commodities
(Thousands of Tons)

Commodity	Source	Total Tonnage All Modes	Motor Carrier Tonnage	Percent of Total	Water Tonnage	Percent of Total
Forest Products	1	83,289	44,726	53.7%	1,082	1.3%
Chemicals	1	172,153	77,125	44.8	21,863	12.7
Primary Metals	1	158,455	84,773	53.5	6,496	4.1
Petroleum	1	310,197	70,104	22.6	210,279	68.8
Agricultural Chemicals	1	50,767	19,062	37.5	2,737	5.4
Coal	2,3	595,386	65,633	11.0	69,825	11.7

SOURCES: Census of Transportation, 1972.
Coal Traffic Annual, National Coal Institute, 1979.
Coal Facts, National Coal Institute, 1979.

the expense of the railroads. Examples include truck shipments to marine terminals on major waterways (grain is received predominantly by truck on the Illinois and Upper Mississippi rivers), truck shipments of grain milling or processing plants and truck shipments to coastal ports for export.

COMPLEMENTARY MOVEMENTS

Motor carriage complements other modes quite extensively through the intermodal movement of bulk commodities. Some examples, structured by commodity, are shown in Table VI-9.

Table VI-9

Selected Complementary Movements of Bulk Commodities

Commodity	Type of Movement	Complementary Mode
Agricultural Products	Rural elevators, producer to/from transport terminal	Rail Water
	Local distribution from elevator	Rail
Coal	Mine mouth to transport terminal	Rail Water
	Transport terminal to consumer	Rail Water
Forest Products	Producing area to transport terminal	Rail Water
	Destination terminal to consumer	Rail
Primary Metals	Distribution from warehouse	Rail
Agricultural Chemicals	Transport terminal to consumer	Rail Water Pipeline
Petroleum	Transport terminal to consumer	Rail Water Pipeline
Chemicals	Transport terminal to consumer	Rail Water Pipeline

SHORT- AND LONG-TERM POSSIBLE EFFECTS OF LIMITED MOTOR CARRIER DEREGULATION

For-Hire Carriers

Short-Term

- More truckload competition
- Truckload depressed, greater variance, more frequent adjustments
- Shift in traffic land profitability
- Lower overall profit

Long-Term

- Fewer, larger carriers
- Many small truckload carriers, high turnover
- Operating authority no longer a major asset
- Railroads and, quite possibly, water carriers, may be more of a factor in motor carrier industry as joint modal ownership becomes common
- Differing rates for different levels of service
- Rates adjusted to better reflect cost and value of service
- More contract rates

Private Fleet

- Greater in number, some with LTL service, greater service area
- Economically benefited by profitable backhauls with fewer empty miles
- Stiffer common carrier and truckload competition
- As truckload rates decrease, private fleets may become less desirable

Shipper

- Fewer LTL alternatives, more truckload alternatives
- More rates and adjustments to manage

EXHIBIT VI-2

STRUCTURE OF THE MOTOR CARRIER INDUSTRY

	Economic Regulation	Commodities Handled	Authority	Areas Served	Who Served	Comments
Private	None	All	None	All	Only primary business of owner	May handle exempt conditions as "for hire" carrier. Tend to concentrate on truckload traffic.
For Hire Intercity						
A. Interstate Common Regular Route General	ICC Approved Rates	General (Primarily Manufactured Goods or Materials)	ICC Certificate	Between specific points and their commercial zones on fixed routes	All Shippers in area of authority	May handle exempt commodities. Tend to concentrate primarily on less-than-truckload traffic.
B. Interstate Common Regular Route Specialized	ICC Approved Rates	Specialized Limited (e.g., Petroleum, Household Goods, Chemicals, Motor Vehicles)	ICC Certificate	Same as above	All Shippers in area of authority	May handle exempt commodities if equipment permits.
C. Intrastate Common	State Regulatory Commission	Varies - Limited to Intrastate Commerce	State Granted	Varies	Varies	May be regulated or unregulated according to state guidelines.
D. Interstate Common Irregular Route General	ICC Approved Rates	General	ICC Certificate	Between and/or in general areas over available routes	All Shippers in area of authority	May handle exempt commodities. Tend to concentrate on truck-load traffic.
E. Interstate Common Irregular	ICC Approved Rates	Specialized; Limited	ICC Certificate	Between and/or in general areas over available routes	All Shippers in area of authority	May handle exempt commodities if equipment permits.
F. Interstate Contract	ICC Approved Rates By Contract With Shippers	Varies	ICC Certificate	Varies	Only limited number of Shippers	Operates under well defined contractural arrangement.
1. For Hire Local	ICC or State/ Local	Varies	Varies	Generally within commercial zone	All Shippers	May be unregulated haulers of interstate commerce; generally referred to as local.
1. For Hire Exempt	None	Unprocessed Agriculture, Livestock, Forest Product	None	All	Shippers of exempt commodities	Generally referred to as owner-operators.

VII - INLAND PORTS AND TERMINALS

INTRODUCTION

Inland ports and terminals are responsible for providing those services which support the inland water transportation industry, and those facilities necessary for the transfer of cargo from one transport mode to another. Generally, inland ports and terminals are intermodal in nature. An efficient waterways system brings cargo as close as possible to the shipper and receiver, by water. Terminal pipeline, rail, and truck services within intermediate and shorter haul ranges are then used to complete the intermodal movement.

PROFILE OF INLAND PORTS AND TERMINALS

Ports originally were established to take advantage of natural topographical features. Industries frequently were developed adjacent to port facilities to minimize local transportation requirements. Urban growth resulted in the loss of available land, forcing industry to choose sites for expansion away from urban centers. Consequently, most port development is occurring away from urban sites.

Inland ports have many features in common with seacoast and Great Lakes ports. The latter are reviewed in Section VIII of this transportation industry overview. However, there are features of inland port and terminal operations which differentiate them from coastal operations.

(a) Number and Size

According to the Mid-America Ports Study (MAP), there are over 100 ports and some 1,900 terminals located along the 25,000-mile shallow-draft inland waterways systems of the continental include over 60 ports and more than 1,200 terminal facilities serving the American heartland.

Major centers using inland ports and terminals include Pittsburgh, at the headwaters of the Ohio; Minneapolis/St. Paul, at the headwaters of the Mississippi; Omaha and Kansas City, on the Missouri; Chicago, on the Illinois; St. Louis, Memphis, and Greenville, on the main stem of the Mississippi; and Tulsa, Little Rock, and Pine Bluff, on the Arkansas. The MAP study, conducted by the Maritime Administration, concludes that over 1,000 specialized new terminals will be necessary on the Mississippi River system to handle expansion of river tonnage by the year 2000.

(b) Handling Equipment

The MAP study reviewed inland and Gulf terminal operations in 17 states; (see footnote 10 and Figure VII-A on the following page). Of the 1,198 facilities inventories, almost 70% are single cargo facilities. An additional 15% handle two cargo types, with the final 15% handling three or more types of cargo. Single cargo facilities may handle a range of goods within one cargo type, but it remains evident that the majority of inland terminals transfer cargo with similar handling characteristics. Of the single cargo facilities 36% handle liquid bulks, 33% dry bulks, 18% grain, and 13% general cargo.

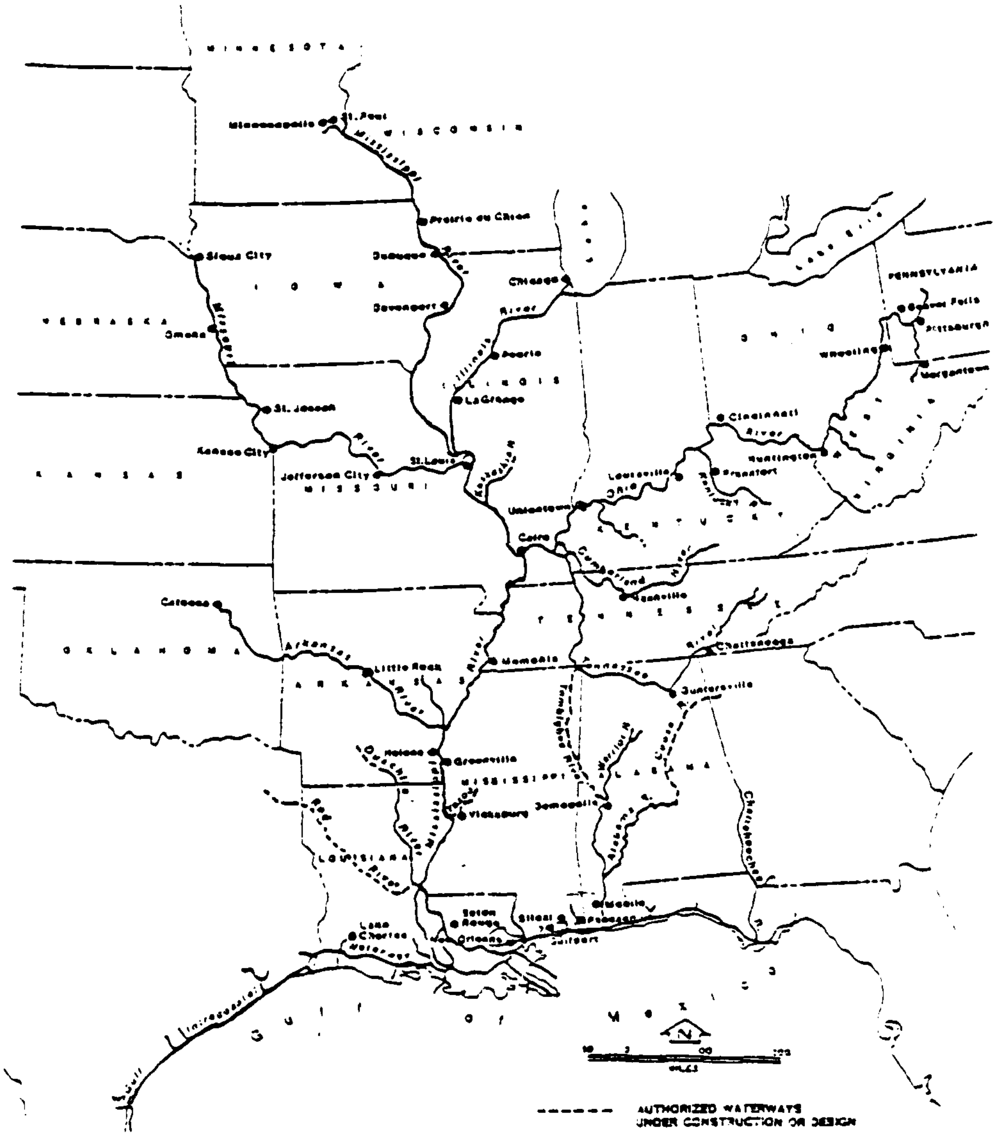
The predominant liquid bulk handling equipment is the barge pump and conventional cargo hose connected to onshore transfer systems with a load/unload capability. More than 200 pieces of loading equipment and nearly 300 pieces of unloading equipment were inventoried.

General cargo, dry bulk and grain handling equipment inventory is listed in Exhibit VII-1.

10 Participating states included: Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Nebraska, Ohio, Oklahoma, Pennsylvania, Tennessee, West Virginia, and Wisconsin.

Figure VII-A

MAP Study Area



SOURCE: Mid-America Ports Study.

Advanced bulk materials handling equipment includes high-volume stacker-reclaimers, inland conveyor systems, catenary conveyors, and automated bulk terminals. It should be emphasized that inland handling costs and improvements are a key element in port and terminal operations. Shippers indicate cargo handling is the area of greatest potential for cost reduction.

Bulk handling technology improvements in inland ports and terminals have significantly improved the efficiency of cargo transfer. Bulk cargo handling tends to be more efficient than nonbulk handling, due to the physical characteristics of the cargo. Bulk commodities have a low susceptibility to damage and are often amenable to continuous materials handling techniques.

Coal and coal products are generally loaded by bucket wheel or tunnel reclaim from storage belt conveyor transport to dockside and either stationary, traveling or quadrant conveyor boom shiploaders. Barge unloading is accomplished by clamshell bucket and continuous bucket elevators. Belt conveyors transfer the coal to storage where it is stockpiled through use of a stacker supplemented by bulldozers and front-end loaders.

Iron ore storage is generally in open stockpiles. Loading systems include bucket wheel or tunnel reclaimers, belt conveyors to wharves, and loading by stationary, traveling or quadrant shiploaders with belt conveyor booms. Unloading is normally accomplished by clamshell buckets, using single or multiple traveling unloaders where required. Ore is transferred to open storage by belt conveyors and stockpiled by traveling stackers. Traveling bridges for unloading, stocking and reclaiming are used where storage is adjacent to the wharf.

Aggregates, nonmetallic minerals and fertilizers involve loading by conveyor boom mounted on fixed or traveling structures or by stationary chutes. Larger facilities reclaim from storage by bucket wheel or tunnel conveyor with the material transferred by belt conveyor to the dock. Unloading at larger terminals is generally by

clamshell bucket operating from fixed towers, traveling bridges, or gantries. Smaller facilities use crawler cranes. Materials are either unloaded for direct transshipment or transferred by belt conveyor to storage and stockpiled by boom stacker or overhead tripper.

Grains generally require covered storage. Unloading from barges can be accomplished by use of pneumatic vacuum pipes, bucket elevators or grab buckets. These devices can be mounted on traveling towers or gantries and can be used singly or in multiples. Belt conveyors are generally used for transfer along wharves and to storage. Some form of continuous handling system - continuous bucket or conveyor belt - is used by most grain unloading facilities. Loading is accomplished by belt conveyors which move the grain from storage to galleries on the wharf. From this point, grain is usually loaded into the vessels by spouts, some with mechanical trimmers. Loading spouts may be stationary or on traveling towers. With adjacent storage silos, the grain may be gravity loaded directly into the vessel by spouts without the need for wharf gallery conveyors. Most grain loading is accomplished by direct conveyor belt system while a smaller portion is provided by gravity chute loading spout.

Since nonbulk cargo volume at most inland ports is very low, specialized handling gear cannot generally be justified. In locations where sufficient nonbulk traffic has been attracted, such as Memphis, Tennessee, appropriate handling techniques have been developed. Crane manufacturers recognize this container handling market and are producing specialized models designed for riverports.

In addition, mobile floating cranes are available to serve areas which do not have sufficient volume to justify container handling facilities. Interface expense at the coastal port is reduced when containers are moved on the specialized barges required for LASH (lighter aboard ship) or SEABEE barge-carrying vessels.

(c) Financial

Most docks and terminals on inland waterways have been developed and are operated with private capital. Many

serve a single purpose and are not used by the public. Publicly-owned terminal facilities are typically operated by private firms under long-term leases from public authorities.

The River and Harbor Act of 2 March 1919 (Public Law 323, 65th Congress) in Section 1 stated the policy of the Congress that...at least one public terminal should exist, constructed, owned, and regulated by the municipality, or other public agency of the State and open to the use of all on equal terms. The Corps of Engineers is the federal agent for planning, improving, and maintaining navigable waterways. The planning activities include engineering feasibility studies, cost analyses, economic assessments, and environmental impact statements. In addition, the Corps prepares detailed budgets for consideration by Congress, which authorizes and appropriates funds for specific river and harbor improvements and operations and maintenance of existing river and harbor projects.

Section 8 of the Merchant Marine Act of 1920 directs the Maritime Administration of the United States Department of Commerce to promote, encourage, and develop ports and transportation facilities for water commerce. The Maritime Administration prepares studies of port economics, the flow of commerce, congestion at ports, and rates, charges, rules, and regulations of common carriers. The Act requires the agency to review water terminals, including docks, warehouses, and related equipment; to provide advice to communities relevant to local planning for wharves, piers, and water terminals; and to investigate the practicability of harbor, river, and port improvements.

Federal policy supports cooperative planning with state governments through such organizations as the river basin commissions established in accordance with Title II of the Water Resources Planning Act of 1965. Commissions have been established in the Ohio, Upper Mississippi, and Missouri basins.

An illustrative commission is the Upper Mississippi River Basin Commission, which was created in 1972. It is comprised of representatives of six states and ten federal

agencies. The commission organized the Great River Environmental Action Team (GREAT) which has been engaged in a comprehensive multipurpose resource management study for the Upper Mississippi River. The objective of GREAT activity is to develop a plan for the river incorporating total water resource requirements, including commercial navigation, fish and wildlife, and recreational river use. Problems involved with channel maintenance and placement of dredge materials are key issues.

States represented on the Upper Mississippi River Basin Commission are: Illinois, Iowa, Minnesota, Missouri, North Dakota and Wisconsin, with South Dakota participating as an observer. Federal agencies with membership on the Commission are: Department of Agriculture; Department of the Army; Energy Research and Development Administration; Department of Commerce; Environmental Protection Agency; Federal Energy Regulatory Commission; Department of Health; Education and Welfare; Department of Housing and Urban Development; Department of the Interior; and the Department of Transportation. State members are appointed by department or agency heads.

The major role for state government in inland port development is the establishement of firm legislative authority for the exercise of local initiatives. An alternative but less common procedure is for the state to assume ownership and operating jurisdiction of those inland ports and terminals located within its boundaries. State enabling acts or statutes specify the manner in which local governments may set up an authority, and empower authorities to perform one or more of the following functions:

1. Acquire, construct, and equip docks, warehouses, terminals, and related facilities.

2. Construct, acquire, maintain, and operate basins and canals.

3. Exercise the right of eminent domain for acquisition of land, rights-of-way, and easements.

4. Enter into contracts, leases, and other agreements with companies engaged in transportation, storage, or shipment of goods and commodities.

5. Receive grants, gifts, donations, or other monies from the federal government, the state or its political subdivisions, or other public agencies.

6. Incur debt and issue bonds or notes, pledging revenues derived from their properties and facilities or received from other sources.

7. Promote, advertise, and publicize their port facilities.

8. Appear before regulatory agencies on behalf of the port and its users.

Public riverport facilities are financed largely with local and state support. Financing methods for major capital investment include:

1. Direct appropriations and grants from general revenues of the government.

2. Long-term borrowing through general obligation or revenue bonds.

3. The exercise of taxing authority for specific public purposes.

4. Long-term loans secured by mortgages on facilities.

5. Short-term borrowing from public or private institutions.

6. Operating revenues.

When state and local governments undertake development of port facilities, they frequently issue general obligation bonds which pledge the full faith and credit of the issuing governmental entity. The primary security of these bonds derives from the taxing power of the issuing or guaranteeing government.

Close coordination with economic development activities, as supported by grants from federal or state sponsors, is frequently the key to developing financially

viable port plans. For example, regional commissions can be established as supplemental granting agencies for terminals, docks, and industrial parks. When a basic grant is obtained from a federal agency, these commissions can provide supplemental grants if the following conditions exist:

1. Matching funds cannot be raised.

2. Eligibility requirements can be met by the applicant.

3. Funds remain available.

Since development, maintenance, and operation of general cargo handling facilities are rarely an economically viable enterprise for private investors, the organization of such facilities under public management may be the only feasible procedure. The tax exemption associated with public sponsorship of port facilities is a significant element of public support for riverport facility development.

Nonmonetary assistance by state and local governments can also play a significant role in a port facility development program. For example, a long-term lease may be extended to port authorities requiring minimal payment. The port authority manages development of the facility and leases it to tenants under conventional rental agreements. To finance facility development, the authority may permit a tenant to withhold a portion of his rental payment. When completed, title to such facilities passes to the authority.

Title V of the Public Works and Economic Development Act of 1965 authorized creation of regional development commissions in areas other than Appalachia (which is served by the Appalachian Regional Commission). A recent amendement to this act states that all states evaluated during the MAP study are now served by one or another of the Title V commissions. Most of the funds distributed by Title V commissions have been used to supplement other federal contributions to development projects, such as industrial parks, sanitary engineering facilities, water systems, access roads, airports, and vocational schools.

OPERATIONS

In general, private terminals are operated by the shipper of the cargo or commodity. Terminal services are also available for hire, including those provided by inland waterway carriers.

Carriers decide to operate terminals on the basis of marketing and strategic information. For example, a liquid cargo carrier may determine that individual customers lack sufficient volume to justify such investment on their own. By providing a terminal to handle bulk liquid cargo, the carrier can increase his share of the shipping market.

Capital has become more readily available to barge and towing operators due in part to the involvement of leasing companies in the industry. Since capital has become more available, more flexibility in expansion of terminal services can be anticipated.

Navigational conditions, such as the closing of the Illinois River due to freezing, can cause the elimination of waterway segment cargo flow. In addition, inland ports and terminals must continue to deal with costly and highly complex decisions on the levels of inventory required for stockpiling during such winter periods.

A study of the Port of Metropolitan St. Louis revealed that the cost of port operations, on average, is nearly equal to the expense of barge linehaul transportation. In many cases the cost of port activities has exceeded the expense of linehaul river transportation, making port operations a key consideration in total transportation cost. The operating cost breakdown is estimated in the table below.

As a result of the desire of industrial development agencies for site promotion and the lack of overall port planning, inland ports have developed at random, with facilities spread out along the riverfront. Fleeting costs to support such facilities are higher than they would have been with coordinated planning. A traditional

Table VII-1

Port of Metropolitan St. Louis

Door-to-Door Average Cost Profile

Elements	Weighted Average Cost per Ton	Percent
Linehaul	$3.06	55%
Fleeting	.24	4
Handling	.98	18
Feeder/Distributor	1.28	23
Total	$5.56	100%

SOURCE: A. T. Kearney, A Primer on Inland Waterway Ports, East-West Gateway Coordinating Council, 1976.

type of development on inland waterways is "one plant - one dock", resulting in capital intensive cargo handling.

Consequently, the development and maintenance of most docks represents large sunk costs in relation to each ton of cargo handled. Little weight is usually given to the impact of dock operating efficiency in industrial site selection. In fact, the cost of a dock facility is a relatively minor portion of the total capital investment for a major industrial facility.

Potential exists for improving operating efficiency at inland ports and terminals. This could best be accomplished by consolidating cargo handling facilities and the industries they support. The result would include better return on the capital invested in dock facilities; simplified fleeting, railroad, and trucking activities; and more productive use of land best suited for riverfront development. However, a common terminal has a potential disadvantage of being more distant and less accessible to the user plant facilities.

TRENDS

The MAP study facility development scenarios were written to satisfy the cumulative projected cargo handling deficit by the year 2000 for the 17-state study area. More than $9 billion in new port facility investment will be required during the coming 20-year period to meet cargo handling requirements.

The investment will go for construction of approximately 1,000 new barge berths and the development of between 10,000 and 11,000 acres of waterfront land. Berth construction alone will result in about 17 million cubic yards of dredge material requiring proper disposal.

Figure VII-B on the following page illustrates development requirements for a scenario in which a greater proportion of large facilities exists through consolidation of port terminals.

Conclusions drawn from the study include the following:

1. Inland port capacities will be 700 million tons short of projected requirements by the year 2000.

2. The greatest need for port and terminal expansions is in Louisiana, followed by Alabama, Arkansas, and Mississippi.

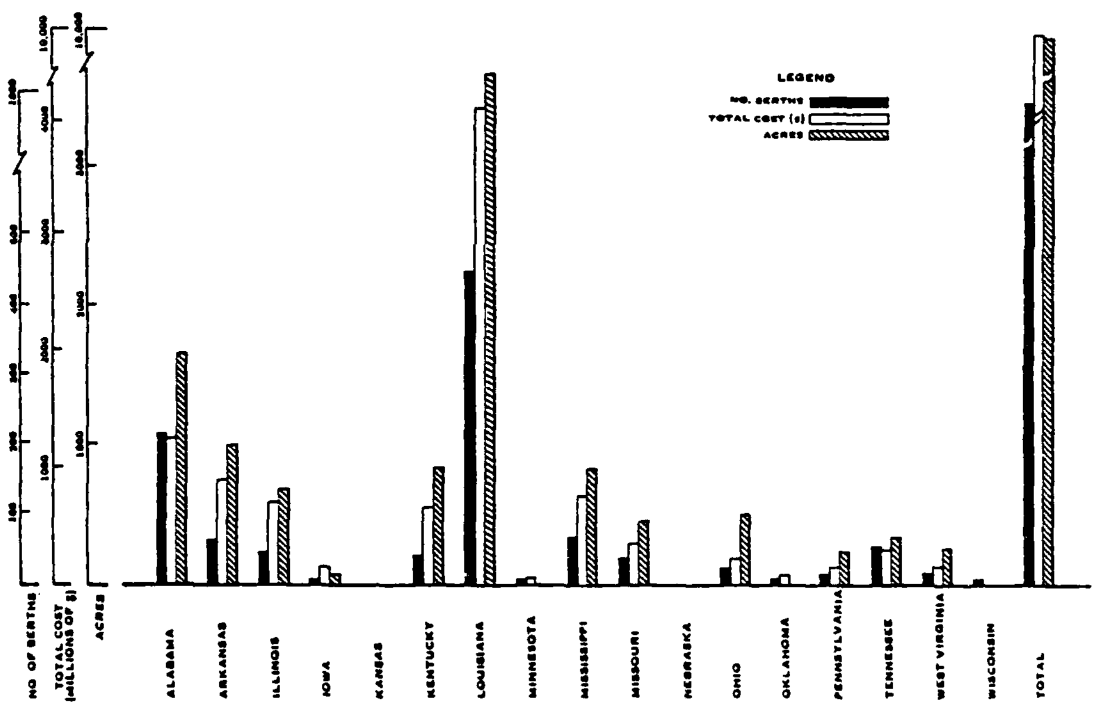
3. The largest investment by facility type will be petroleum product handling, followed by coal, grain, fertilizer, and chemical handling facilities.

(a) Intermodal Transport

Combined rail and barge movements for coal and grain have risen in the last few years. Railroads are aware that such cooperation with barge operators can result in higher profits, lowered fuel requirements, and improved use of equipment. Inland ports and terminals are key factors in this shift toward intermodalism.

Figure VII-B

Forecast Development Needs



Source: Mid-America Ports Study.

The Gulf Coast practice of barge carrier operation has implications for international trade from inland ports and terminals. A typical operation might involve a high-speed barge-carrying vessel arriving in port and discharging a number of barges, either LASH or SEABEE type, which are towed to inland or coastal destinations. The vessel will then have onloaded barges assembled earlier, and depart for overseas ports. Through this procedure, LASH/SEABEE systems can greatly reduce port interface charges.

Expansion of the LASH barge trade has been encouraged by sufficient volume of suitable traffic at inland ports including Lake Providence, Vicksburg, Natchez, Greenville, Memphis, St. Louis, and Louisville. Consolidation of ports and terminals can help provide sufficient general cargo volume to justify specialized equipment investment, although an economic trade-off occurs due to the need for increased feeder and distributor hauls.

There appears to be an increasing interest by river-ports in export shipments via LASH/SEABEE, due to the favorable rates of through bills-of-lading. As this trend develops, additional improvements in cargo-handling facilities along the inland waterways system can be anticipated for general high-value commodities. The future growth and success of barge carrier operations depends to a great extent upon the effect of rail deregulation and inland shippers ability to establish an international through-rate to compete with traditional shippers.

The river port is the junction for various modes of transportation. An opportunity exists for cooperative planning with shippers and carriers for the development of equipment, handling techniques, and administrative procedures to improve the overall efficiency of both domestic and export/import trade. Coal terminals such as those in St. Louis and Coro, Illinois, are recognized examples. Inland coal and grain terminals have generally been developed through cooperative planning.

(b) Foreign Trade Zone

Specialized inland ports and terminals may anticipate an increasing opportunity for international trade activity through the establishment of a "foreign trade zone". Such ports as Kansas City, Little Rock and Louisville have established foreign trade ports.

A foreign trade zone is real estate physically separated from surrounding property and not considered a part of the United States for customs purposes. Products may be imported into the foreign trade zone, processed and/or packaged, and reexported internationally without incurring United States custom duty. Some products may be distributed domestically, with duty charged upon their leaving the foreign trade zone and then only in proportion to the imported component of the product.

(c) Port and Terminal Development

Only the United States, among the major nations, assumes that channel and harbor improvements are a national function, which development of port facilities is primarily a local responsibility.[11] In recent years, a number of local and regional port authorities have been established through state legislation and interstate compact to oversee the orderly and effective development of riverports.

During the next few decades, developmental emphasis from port and terminal operators on the inland waterway system will shift from navigation channels and harbors to waterfront facilities, since the waterway system is largely in place. The low-cost waterways have already been developed while newer ones, such as the Tennessee-Tombigbee Waterway, involve substantial public investment. Such projects face increasing legal challenges growing out

11 National Academy of Sciences, Port Development in the United States (1976).

of sophisticated intermodal evaluation, more extensive use of investment analysis for public projects, and electoral pressure to generally restrict public expenditures.

SUMMARY OF OPERATING TRENDS

The reduction of costs incurred for moving cargo within port areas can be accomplished through the development of inland ports around one or more waterside industrial parks, where river users share a single, well-managed dock facility. A general trend toward consolidation of terminal operations is becoming evident, due, in part, to high real estate costs and old or obsolescent terminal facilities. Interviews with chemical industry representatives during NWS reveal some interest in consolidation. The growing competition for waterfront space makes it feasible in some locations to sell outdated facilities and remove terminal equipment. Existing and new facilities will be subject to productivity improvements based upon new technology in tank design, vapor recovery, emission control systems, and materials reclaim and transfer.

RATE STRUCTURE

Inland port and terminal interests believe a system of "equalized" rail rates in the export-import mode of cargo is outmoded, and imposes a "limited growth" and in some cases, a "no growth", posture. Originally, equalized rail rates created a structure ensuring that such ports as New Orleans, Mobile, and Houston would receive export cargo at the same rail rate, regardless of the differences in distance of shipments. Today, such industry groups as Inland River Ports and Terminals, Inc. claim that this specially-devised export rail rate structure creates an unfair competitive practice favoring certain coastal ports.

With advances in transportation, including the St. Lawrence Seaway, containerization, LASH, SEABEE, and mini-ships, inland and Great Lakes ports have acted as designated Ports of Entry, with export services essentially the same as those provided by coastal ports. Currently all rail shipments, export as well as domestic, move to the

inland ports at domestic rates only, with no rate distinction between the export and domestic shipment. There is inherent potential in the inland waterway distribution of export waterborne cargo through the avoidance of congested coastal port operations.

TECHNOLOGY TRENDS

The primary technological trend in inland ports and terminal operations involves the increase in the rate of transfer for bulk cargo.

Small facilities may have an immediate opportunity for the improvement of handling capability, largely because of available handling technology. It is more difficult to improve handing capabilities at large facilities because they are generally now using more advanced capital intensive methods. Many of these methods are nearing inherent design limits.

By 1990, dry bulks, including coal, ores, and grains, will show the most significant gains in rates of transfer based on handling technology design. Liquid bulk will show a moderate increase in transfer rate, due to increased operating pressures of land systems and the use of booster pumps.

The trend toward containerization is evidence of the improvement in the rate of transfer of general cargo and selected bulk commodities. Since container handling facilities are capital intensive, small general cargo terminals may face competition from larger better equipped terminals. Container movement by barge will play a minor role by volume in inland waterway traffic, although the high value of container cargo encourages specialized capacity at inland facilities.

REGULATIONS

(a) Environmental

Federal and state laws have been enacted to minimize the impact of port development and operation on both river

and coastal environments. Federal laws of significance include:

1. The Clean Air Act with amendment of 1977.

2. Resource Conservation and Recovery Act of 1976.

3. Federal Water Pollution Control Act, as amended by Clean Water Act of 1977.

4. The Rivers and Harbors Act of 1899.

5. Water Research and Development Act of 1978.

6. Water Resources Planning Act of 1965.

7. Fish and Wildlife Coordination Act.

8. Port and Waterways Safety Act of 1972.

9. Noise Control Act of 1972.

10. Coastal Zone Management Act of 1972.

11. Endangered Species Act of 1973.

12. Soil and Water Resources Conservation Act of 1977.

For example, the Federal Water Pollution Control Act Amendments of 1972 set, as a national goal, complete elimination of pollutant discharge into navigable waters by 1985. To assist in meeting this objective, the Environmental Protection Agency administers a nationwide federal-state water permit program known as the National Pollutant Discharge Elimination System. This program outlines point source effluent standards and limitations that pollutant dischargers are required to meet.

Inland ports and terminals must deal with additional major environmental problems including:

1. Dredging effects. Removal of dredged material and redisposition of sediment changes marine habitat, and influences associated species of marine life. Inland

ports and terminals face continuing problems from river silting. Affected state and local governments often have legislative authority to allow the establishment of proper sites for the disposal of dreged material.

2. Dredging material. Dredged material can be deposited in off-channel areas or on land. Each choice has environmental drawbacks. For example, off-channel disposal may affect marine life or shift current patterns, while land disposal can change existing land forms and surface cover. Strict guidelines, while protecting the environment, can retard inland port and terminal growth by increasing the time required to react to new economic opportunities.

The effect of the spills of cargo which may occur during transfer operations can lead to disastrous environmental and economic consequences for terminals, carriers, and the general public. Liability for the results of incidents involving environmental and general safety has increased, causing a dramatic rise in insurance rates.

(b) Economic

The National Transportation Policy Study Commission has recommended regulatory reform, while promoting joint rates and through service. Policy recommendations are broadly addressed to reducing and equalizing regulations among transportation modes and providing an improved competitive environment. While inland water carriers have been primarily unregulated, deregulation of rail and motor carriers will affect the intermodal aspect of port and terminal operations as well as the level of competition for single mode linehaul movements.

Since market freedom is founded upon neutral public policies, the effect of competition is expected to eliminate inefficient carriers or induce improved procedures. Rural and sparsely populated areas may gain from better service (perhaps at higher rates more reflective of costs) and high density intercity markets may gain as well from continued service at reduced rates closer to costs. Inland ports and terminals, as key transportation links, can be expected to reflect the results of both modal competition and cooperative planning.

(c) Safety

Safety issues and operating practices are regulated by both the United States Coast Guard and the Occupational Safety and Health Administration. Inland ports and terminals face safety issues in dock site selection and design. For example, the location of a dock near a main river channel may increase the risk of damage from floating debris, breakaway barges, or passing tows.

The risk of collision of tows with inland docks is greatest when a tow is approaching a dock with unknown current effects. Since industry outflow or discharge often occurs at or near a dock site, an additional contributing factor to current effect is frequently present. If high wind is present, the risk increases further.

Mooring methods for both bank fleets and anchor fleets must include safety provisions in operations to store and retrieve barges. Protected off-stream harbors, although costly, can effectively reduce the risk of frequency and severity of collision incidents.

HR 2994 to amend the Ports and Waterways Safety Act of 1972, provides for matching grants to municipalities and public agencies "to enable those authorities to protect deep draft commercial ports and land areas adjacent to those ports from fires, explosions, or other incidents causing damage in the ports, and for other purposes". This bill was developed through a port caucus with a strong influence of deepwater ports. It has become evident that inland ports and terminals are exposed to the same problems and deserve the same recognition as deepwater ports in this area of federally mandated, nonrevenue producing costs.

(d) Competing Uses

Provision is made for the recognition of competing [illegible] for land and water use, in areas associated with [illegible] ports and terminals, during approval phases of site [illegible] and/or expansion. Regulations at the federal [illegible], as well as codes enforced by local units [illegible] requirements for public benefit.

Examples of competing uses would include agriculture, recreation, and natural or historic site preservation.

SUMMARY

Inland ports and terminal activities have evolved into complex intermodal operations serving expanded domestic and import/export markets. The growth of inland waterways cargo tonnages will require planned support from port and terminal operators.

Decisions must be made on the expansion or consolidation of services and capital investment in cargo handling and pollution control technology. Such investment will be based on the assessment of economic demand as balanced by environmental considerations. The dual problems of the location of suitable riverfront land and generation of capital for advanced technology may be solved in part by the consolidation of operations. The increasing involvement of public agencies at the state and federal levels indicates that operations traditionally under local control will face increasing regulations. The consolidation of operations may lead to administrative and operating practices which can meet both tonnage and regulatory requirements.

CARGO HANDLING EQUIPMENT

Handling Equipment Type	Total
General Cargo	
General Cargo/Container Crane	93
Container Crane	13
Straddle Carrier	3
Lift Truck with Spreader	4
Yard Crane - Other	54
Locomotive Crane	37
Front-End Loader	52
Crane with Magnet	22
Crane with Clamshell Bucket	52
Bridge Crane	13
Forklifts	225
Shoreside RO/RO Ramp	4
Other	88
TOTAL GENERAL CARGO	660
Dry Bulk	
General Cargo/Container Cargo	15
Yard Crane - Other	43
Shiploader (1)	36
Gantry Crane Unloader, Single Bucket	51
Pneumatic Loader	8
Pneumatic Unloader	17
Marine Leg (Continuous Bucket)	20
Gravity Chute Loading Spout	19
Locomotive Crane	18
Front-End Loader	193
Crane with Clamshell Bucket	196
Bridge Crane	17
Bulldozer	19
Conveyor Belt System	199
Other	150
TOTAL DRY BULK	1,006

Handling Equipment Type	Total
Bulk Grain	
Shiploader (1)	47
Pneumatic Loader	2
Pneumatic Unloader	2
Marine Leg (Continuous Bucket)	27
Gravity Chute Loading Spout	81
Crane with Clamshell Bucket	9
Conveyor Belt System	110
Auger	4
Other	38
TOTAL BULK GRAIN	320

NOTE: (1) Slewing chute, gravity loader, conveyor belt feed.

SOURCE: Port Facility Inventory - Mid-America Ports Study.

VIII - SEACOAST AND GREAT LAKES PORTS

INTRODUCTION

This section discusses Seacoast and Great Lakes ports. Vessel loading at these ports is governed by such factors as vessel design, port channel depth, weather, tidal conditions, and limitations of the Welland Canal and the Panama Canal. Ocean and Great Lakes ports are links to routes utilized in foreign trade and coastal domestic trade for general cargo, neobulk, bulk, and specialized general cargo.

A port regularly provides accommodations for the transfer of passengers and/or goods to and from water carriers. In general, a port may be said to have three parts:

1. A harbor providing sufficient channel and adequate shelter.

2. Waterfront facilities, which include one or more piers, wharf sheds, warehouses, or other facilities for handling passengers, cargo, fuel, or ships' supplies.

3. Floating equipment in the harbor.

Facilities which belong to and are administered by ports normally include such services as refueling, water supply, power, repairs, and stores. Floating harbor equipment will normally include tugs for moving ships to and from berths, lighters for cargo offload, floating cranes for cargo handling, and fire fighting craft.

The management of the seaport involves:

1. Administration of capital resources.

2. Operation and maintenance of the physical plant.

3. Solicitation and retention of qualified users of the port's services.

4. Budgetary planning and control.

5. Long- and intermediate-range planning to meet the forecast needs of world commerce.

6. Liaison with numerous governmental agencies and compliance with their regulations.

PORTS PROFILE

The port is a public utility service, whose growth and activities have a vital connection with the development of commerce with the harbor and tributary areas. A broadening concept of this interest will lead communities with a common harbor to establish some degree of central control over adjacent ports. This orientation is traceable also to the multimillions of dollars of existing port investments, frequently yielding income measured in millions of dollars (see Table VIII-3 in the Finance subsection).

America's problem in competing for foreign trade is to overcome the high cost of long-distance interior transportation and handling. In part, this problem can be reduced by the efficiency of seacoast and Great Lakes port operations. Lower costs and better service are essential to trade expansion in both foreign and domestic ocean markets.

The throughput of a port is limited by:

1. The capacity of inland carriers serving the port.

2. Waterfront facilities of the port.

3. The ships available.

Specialized ports are typically developed around terminals and berths designed to support certain types of ships and feeder vehicles. Examples include:

1. Liquid bulk terminals with inland pipeline feeder connections.

2. Dry bulk terminals with mechanized, conveyor fed transfer systems.

3. Container terminals for quick ship turnaround, with inland feeder capability and extensive parking lot marshalling capacity.

By way of contrast, traditional breakbulk handling accounts for over 40% of existing operations at seacoast terminals and involves:

1. Unloading of railcar or truck vessel and placing cargo in a transit shed.

2. Guarding and handling cargo in the shed.

3. Moving cargo from storage to vessel (railcar or truck).

(a) Number and Size

The Maritime Administration indicates that there are approximately 130 coastal ports with depths of 25 feet or greater, and 2,400 operating marine terminals capable of accommodating world commerce. More than 60% of the terminals are privately owned and operated by various industries. These facilities are usually designed to handle a single commodity or group of commodities as an integral part of a firm's production process.

Great Lakes ports and terminal activity is illustrated in Table VIII-1.

(b) Ownership

Public ports and terminals handle bulk cargo, general cargo that historically moves in breakbulk form, and more recently, in unitized form. The ownership distribution of United States terminal facilities is illustrated in Table VIII-2. Public ports are owned by a wide variety of

Table VIII-1

Number of United States Great Lakes Ports and Terminals by State and Cargo Services (1)

	New York	Pennsylvania	Ohio	Michigan	Minnesota	Wisconsin	Illinois	Indiana
Grain Elevators	2	0	2	1	1	2	1	0
Ore								
Load	0	0	0	2	4	1	0	0
Unload	1	0	6	2	0	0	1	3
Coal								
Load	0	0	5	0	0	1	1	0
Unload	1	0	1	27	3	6	0	0
Sand, Stone, and Various Dry Bulk	4	1	10	34	1	7	4	4
General Cargo and Steve-doring	4	1	3	7	1	4	2	1
Liquid Cargo and Bunkering	6	1	3	29	4	8	1	1

NOTE: (1) Multiple cargo services at many locations.

SOURCE: Greenwood's Guide to Great Lakes Shipping, 1979 edition.

Table VIII-2

Ownership of Terminal Facilities
(Estimated)

Type of Ownership	Number of Terminals	Percent of U.S. Total
Private (profitmaking organizations)	1,488	62.0%
Local Government Agencies	576	24.0
State Government Agencies	288	12.0
United States Government Agencies (nonmilitary)	43	1.8
Private (nonprofitmaking organizations)	6	0.2
TOTAL	2,401	100.0%

SOURCE: M.I.T. Center for Transportation Studies, Federal Port Policy in the United States (1977).

governmental agencies, ranging from local government and state authorities to federal and quasigovernmental organizations. Local and state governments have a particular interest in port activity, because this often represents a dominant economic factor for the port city and surrounding area.

(c) Equipment

The broad range of port operations requires equipment for:

1. Terminal rail switching.

2. Rail, barge, truck loading and unloading.

3. Securing freight in or on railcars or trucks.

4. Fumigation.

5. Coal storage.

6. Warehousing.

7. Weighing, sampling, segregation, and bagging.

8. Bulk liquid pumping and storage.

9. Bulk grain elevation and storage.

10. Consolidation and containerization.

11. Barreling, drumming, and crating.

12. Dry bulk storage and reclaim.

13. Bonded warehousing/foreign trade zone activities.

All of these functions are in addition to the basic operation of unloading or loading the cargo from or onto the land carrier. The other part of the port function, the loading and discharge of the vessel, is a special operation handled by stevedoring firms.

The design of cargo terminals and associated equipment considers:

1. Size and character of the vessels which will use the terminal.

2. Volume and kind of traffic which may be anticipated.

3. Modes of inland transportation that will serve the terminal.

4. Availability of adjacent warehouse facilities.

5. Mechanical equipment required for cargo handling.

Composition and volume of cargo is so varied that handling and storage capacity must provide flexibility. Inland transportation by rail, truck, barge, and airline generates additional requirements for varied handling equipment and associated services.

Basic principles applied to design of terminal facilities and equipment selection are based upon considerations of:

1. Safety to cargo and structures, as well as to personnel in the port area.

2. Flexibility in response to cargo volume and type.

3. Speed, as measured by the number of handlings, direct movement to and from ship, and movement on the wharf area.

4. Economy, as most handling costs are borne by the shipper.

In summary, the range of equipment required can be illustrated by considering a list of typical port facilities:

- Wharves and piers.
- General cargo terminals.
- Dry bulk terminals.
- Liquid bulk terminals.
- Container terminals.
- LASH, SEABEE, and RoRo terminals.
- Highway truck facilities.
- Mooring devices.
- Dockside utilities.

(d) Finance

General expenditures of a public port authority include the acquisition of real estate, construction of bulkheads, grading and filling of low areas, provisions

for highway and rail access, and dredging costs. These factors may be prepatory or complementary to construction or expansion of cargo handling facilities.

Possible sources of funds for a port authority include:

1. Taxes levied by the port.

2. Taxes levied by the parent governmental unit or units.

3. Bond issues secured by the taxable wealth of the governmental unit (e.g., general obligation bonds).

4. Bonds and other forms of indebtedness secured by income of the port as a whole, or with specific port facility revenues (e.g., revenue bonds).

5. Appropriations from the budget of the governmental unit.

6. Port revenues.

A financial review was conducted by the American Association of Port Authorities of 31 ports. The results of that study are shown in the table below.

As shown by the table, the return on investment was generally low. These results were attributable to the combined impact of rapid obsolescence and increasing competition between ports.

These results included only direct revenues, and did not address varied forms of direct and indirect subsidies. This latter category would include direct appropriation by national, state, and local governments, and the provision for services at less than cost, or on a reimbursable basis.

The Maritime Administration in its Port Development Expenditure Survey (PDES), examined capital expenditures by public ports for the period 1973 to 1978. Expenditure projections through 1984 were also included.

Table VIII-3

1977 Survey of Financial Data of 31 Ports
(Thousands of Dollars)

	North Atlantic	South Atlantic	Gulf	Northwest Pacific	Great Lakes	California
Gross Investments in Facilities	$25,723	$26,434	$45,327	$50,786	$27,587	$97,496
Capital Funds Expended During Year	5,010	2,766	2,093	5,978	244	5,922
Capital Funds Provided from Sources Outside of Net Revenues	3,916	1,873	919	5,052	38	3,650
Return on Investments						
Before Debt Service	1%	2%	3%	3%	3%	3%
After Debt Service	d(1)	2%	1%	d	d	2%

NOTE: (1) d = deficit.

SOURCE: M.I.T. Center for Transportation Studies, Federal Port Policy in the United States (1977).

Key findings of the PDES include the following:

1. United States ports spent $5 billion on new and modernized pier and wharf facilities from 1946 through 1978, of which $1.6 billion was spent between 1973 and 1978.

2. Some $3.4 billion will be spent by ports for cargo handling facilities from 1979 through 1983.

3. Despite increased expenditures for containerization and other unitized forms of cargo handling, construction of new and modernized breakbulk general cargo facilities is continuing.

4. The North Atlantic region leads the country in total port development expenditures since 1946. Its position of relative dominance has, however, somewhat eroded in face of expenditures by Gulf, South Atlantic, Pacific, and Great Lakes ports.

5. Port administrations are using fewer general obligation bonds for development financing, and are increasingly dependent on revenue bonds and the reinvestment of port revenues.

The PDES reviewed public port expenditures for three types of cargo operations:

1. Conventional general cargo, including piers, wharves, and transit sheds for breakbulk general cargo vessels.

2. Specialized general cargo: piers and wharves; loading/unloading of container; LASH/SEABEE and roll-on/roll-off vessels; and cargo consolidation distribution sheds.

3. Bulk cargo (dry and liquid), including piers, wharves, pierside elevators, liquid storage tanks, and bulk handling equipment.

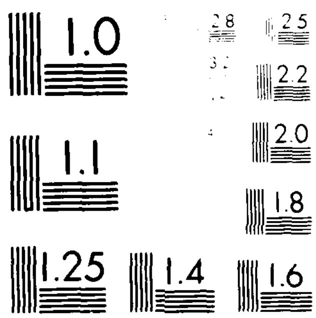
The "new construction" expenditure classification in the PDES includes only work that is completely new, or reconstruction projects that create completely new

AD-A107 366 KEARNEY (A T) INC CHICAGO ILL F/G 15/5
NATIONAL WATERWAYS STUDY OVERVIEW OF THE TRANSPORTATION INDUSTR--ETC(U)
AUG 81 V CHURCHWARD, E ISELY DACW72-79-C-0003

UNCLASSIFIED NL

3 OF 3
AD A
107366

END
DATE
FILMED
12-81
DTIC


1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

berths. The "modernization/rehabilitation" (M & R) grouping includes all additions, improvements, and restorative work to existing facilities which do not result in additional berths. New and M & R proposed expenditures are illustrated by port area in Table VIII-4. Exhibits VIII-1 through VIII-5 provide a detailed listing of proposed expenditures by region and cargo type.

The PDES reveals the increasing use of public financing methods, by region, as follows:

1. Local and state aid for South Atlantic ports.

2. General obligation and revenue bonds for Gulf Coast ports.

3. Revenue bonds and port revenues for West Coast ports.

4. Federal aid for Pacific Northwest and North Atlantic ports.

Expenditure plans for U.S. ports are being reevaluated in response to increasing demand for United States steam coal from Europe and Pacific Rim countries. Announced terminal expansion plans at the end of 1980 exceed 200 million tons of annual shipping capacity, but actual expansion will depend upon the rate of growth in demand for United States steam coal during the 1980s.

OPERATIONS

There are various types of terminal organizations. These include:

1. Carrier owned or leased terminal, with a stevedoring department or subsidiary which performs most of the terminal operations.

2. The terminal company which is independent, or is a subsidiary of a company handling such cargo as sugar, cotton, coffee, and tobacco. Such terminals often combine waterhousing and waterfront operations. This approach permits central control over shipments from inland ports to the ship's hold.

Table VIII-4

Proposed Port Development Expenditures
(1979-1983)
(Thousands of Dollars)

Port Area	New Construction	Percent	Modernization and Rehabilitation	Percent	Total
North Atlantic	$ 272,950	93%	$ 20,615	7%	$ 293,565
South Atlantic	218,058	98	5,057	2	223,115
Gulf Coast	1,877,123	96	81,333	4	1,958,456
Pacific Coast	555,211	79	143,634	21	698,845
Alaska, Hawaii, and Puerto Rico	28,706	72	10,983	28	39,689
Great Lakes	109,330	69	48,556	31	157,886
Total United States	$3,061,378	91%	$310,178	9%	$3,371,556

SOURCE: Maritime Administration, United States Port Development Expenditure Survey (1980).

3. The terminal service performed by a stevedoring company at a facility leased from the port.

4. The independent private terminal which usually confines its operations to a particular industry. These terminals frequently offer public terminal services, and are competitive with public facilities owned and operated by port authorities.

The type of operating procedures that a port employs are contingent upon the kind of arrangements concluded with the tenants of the port. The basic kinds of operating arrangements are:

1. Leasing of facilities to the operator, either on a long- or short-term basis.

2. Preferential assignments, where the user has a priority on a berth or terminal and scheduling of the use of the facility is at least partially in the hands of the port authority.

3. Quasipreferential assignments, which are informal arrangements with no charge made for priority use of the facility. These assignments are usually based on historical practice.

4. Open or unassigned facility use; *i.e.*, first come, first served.

For example, port facility leasing is a common operating arrangement with steamship lines, general agents, terminal operators or stevedores, and consortia of steamship lines. The consortium is a group of steamship lines which leases a terminal for its common use. The most common type are consortia of container lines which band together to share the high cost of container terminal operation, due to its expensive specialized equipment.

The desirable major port tenants include steamship companies, since they are usually strong financially and tend to be aggressive salesmen of cargo through the port. Steamship line leases, which allow the tenant to act as a general agent for other lines, provide insurance against future contingencies.

CONCERNS AND CONSTRAINTS TO PORT OPERATIONS

Ports are faced with varied types of operating problems and constraints which either restrict cargo flows or increase costs to shippers or carriers. The scarcity of land for development is a widespread problem in United States seacoast ports. Underdeveloped land is in steadily decreasing supply in the face of continuing demand for waterside land for residential, recreational, industrial and commercial uses. Additional problems and constraints include inadequate channel depths, insufficient dredge material disposal sites, marginal rail service, and bridge obstructions.

Some of the same constraints are in evidence at many ports. For example, lack of land for development is a major constraint for most East, West, and Gulf Coast ports. A lack of disposal sites for placement of dredged material is a constraint associated with many Gulf and East Coast ports (see Table VIII-5).

Most port officials have cited existing main channel depths (40 feet or less) as economic constraints to increased foreign trade. Greater channel depths would make United States goods, such as coal or wheat, less costly on a delivered basis to Europe and Japan, thereby permitting United States producers to obtain greater markets.

Except for Puget Sound, all the ports in Table VIII-5 have had recommendations, proposals, or active projects involving substantial channel deepening efforts. The objective of such effort is to reduce channel constraints which limit the size of vessels that can be accommodated in the port.

Environmental considerations limit the selection of dredge material disposal sites. The dredge permit approval process itself involves costly delays in responding to needs for both channel maintenance dredging and proposed channel deepening efforts. This combination of permit approval time requirements and limited sites for dredge material disposal can be a critical element in port development plans.

Table VIII-5

Port Constraints

Ports	Key Economic Constraints
Baltimore	Unavailability of land, inadequate channel depths, insufficient disposal sites.
Hampton Roads	Unavailability of land at deepwater (in excess of 45 feet) locations, insufficient disposal sites.
Philadelphia	Unavailability of land (City of Philadelphia), inadequate channel depths, marginal rail service.
Chicago	Channel depths limited by Seaway restrictions, 9- to 10-month navigation season.
Galveston	Unavailability of land, inadequate channel depths.
Houston	Periodic rail congestion, inadequate channel depths, decreasing land availability (Houston Ship Channel).
Mobile	Inadequate channel depths and widths, insufficient disposal sites, air quality regulations.
New Orleans/ Baton Rouge	Inadequate channel depths, lock constraint, barge congestion, environmental restrictions.
Long Beach	Unavailability of land, environmental restrictions.
Los Angeles	Inadequate channel depths, unavailability of land, environmental restrictions, insufficient rail trackage.
Puget Sound	Unavailability of land at Port of Seattle, environmental restrictions at Ports of Seattle and Tacoma.

SOURCE: Kearney interviews.

TRENDS

(a) Containerization

Initiation of container service by Matson and Sea-Land marked the beginning of a new era in ocean transport and international trade. Since this time, the general trend toward containerization has been strong, particularly in the North Atlantic and Pacific Coast regions.

Containerization refers to the practice of shipping cargo in a locked steel or aluminum, standard size container. This container is then packed and sealed by the shipper, hauled by a trailer truck, or shipped "piggyback" on a flatbed truck or train to a seaport. The container is loaded into the hold or onto the deck of a ship, waterborne to the port of destination, and then transshipped, again by flatbed truck and/or train to its final destination.

Cargo movement is accomplished without intermediate crating or uncrating, thus minimizing handling and losses due to damage, pilferage, or theft. Gantry cranes at portside can load and unload a container vessel in approximately 20% of the time required for conventional breakbulk handling. The inherent advantages of containerization in the face of conventional breakbulk handling and stowage has led shippers and ocean carriers to increase their use of containerization for general cargoes.

Such commodities as alcoholic beverages, photographic equipment, textiles, and electrical machinery are nearly totally containerized at most ports. Certain bulk commodities have also been affected by containerization, although to a lesser degree than general merchandize. Container-susceptible bulk commodities include grain, asbestos, wood pulp, nonferrous metals, iron and steel, alloys, cotton, fresh fruit, and wastepaper.

The container port provides large cargo handling equipment, with acreage for stacking and storing large containers and chassis. One containership berth, for

example, requires 12 to 30 acres of land for sorting and stacking purposes. The movement of port operations to the urban periphery is becoming essential, and is reinforced by the shift of industry and railroad activities to outlying areas.

Due in part to containerization and the resulting implications for increased port capacity, the concept of a single large modern port in a region has evolved. Such "load centers" appear necessary in response to rapidly rising costs of cargo handling equipment. The "load center" concept addresses the need for full utilization of costly handling equipment to take advantage of savings in ship turnaround time, rapid delivery, and reductions in thefts and damages.

The 1979 rank of leading United States container ports is provided in Table VIII-6.

Table VIII-6

Ranking of United States Container Ports

1. New York, New York
2. Seattle, Washington
3. Oakland, California
4. Long Beach, California
5. Baltimore, Maryland
6. Hampton Roads, Virginia
7. Jacksonville, Florida
8. Honolulu, Hawaii
9. New Orleans, Louisiana
10. Houston, Texas
11. Anchorage, Alaska
12. Savannah, Georgia

SOURCE: Containerization International Yearbook, 1979

(b) Vessel Size

The economy of scale resulting from sailing a large ship over long distances is found in crude oil and dry bulk import operations. Increasing size and draft

requirements of Vary Large Crude Carriers (VLCC) and new dry bulk carriers have long since exceeded typical draft limits of United States seacoast ports.

Major United States refining areas include:

- Philadelphia-New York.
- Gulf Coast.
- Northern and Central California.

Although the Gulf Coast and California areas depend on local crude oil sources, nearly 50% of crude oil for Philadelphia-New York comes from such foreign sources as Venezuela, North Africa, and the Middle East.

The increased size of vessels requires attention to the design and construction of deepwater marine terminals. Although public agencies prefer the multipurpose use of such terminals, shippers claim advantages for single-purpose use, such as the Louisiana Offshore Oil Port (LOOP) now under development.

Alternatives to deepwater marine terminals would include:

1. Increased dredging of seacoast ports, as limited by environmental and geological factors; e.g., prohibitions against the dumping of dredged material.

2. Transshipments from supertankers to offshore terminals, with onload to smaller tankers.

3. Lightering by partial offload of a supertanker to a smaller tanker, with both ships then proceeding to port.

Great Lakes vessel size has increased with the shift to self-unloading bulk carriers. Ports and terminals are faced with increasing demand for more modern loading and transshipment capability to minimize carrier delay.

The impact of delay on Lake carrier operations can be severe. It is estimated that typical turnaround time for a Great Lakes ore carrier from the head of the Lakes to the lower Lakes is six to seven days. If the load/offload process is repeatedly delayed by a matter of six hours at each end, one trip may be eliminated from the navigation season.

Federal funds for capital construction of vessels are now available. The need to use terminal facilities with high maintenance and operating costs has provided further incentive for Great Lakes vessel operators to construct or convert to self-unloaders. The implications for ports and terminals of this trend is the required improvement of loading systems and intermodal transfer from bulk storage to the vessel.

(c) Foreign Trade Zones

Foreign trade zones or free ports are found in 72 countries. Within the United States, 46 zones and five subzones have been established to take advantage of attractive incentives to world industry.

The main purpose of the foreign trade zone is the exemption of goods from customs duties. Duties are applied only when foreign goods are removed from a zone for use or consumption in the country in which the zone is located. Savings may result from lowered taxes, transportation, finance charges, and insurance premiums.

The trade zone is federally licensed and sponsored by a state or local public body with operation assigned to a private organization. The trade zone functions as a public utility in that all manufacturing must support the public interest.

The Foreign Trade Zone Act of 1934 evolved from a need to impose customs duties to protect United States industry. Trade zones have been established in inland areas as well as areas served by deepwater ports.

Traditionally, foreign trade zones have provided services in warehousing, labeling, assembling, and distribution. A trend now is evident toward increased export processing, with the last 15 approved zones authorized to assemble for export.

Exporters find many advantages in the use of foreign trade zones, including:

1. Rapid offload and storage of goods, without the usual customs and other formalities.

2. Improved cash flow, since duties are not payable while goods are in the zone or when they are exported.

3. Complete access to the merchandise at any time and use of warehouse receipts for loans or collateral.

4. Use of space as a product showroom.

5. Opportunity to assemble imported items with domestic/imported components.

6. Manufactured products assessed with a duty rate only on the foreign portion or element of the finished product.

7. Goods processed or manipulated to qualify for lowest possible duties or freight charges.

8. Attraction of international trade, with packaging, repackaging, and labeling services provided.

9. Additional savings arise as users can discard substandard goods within the zones.

RATE STRUCTURE

Since seacoast ports are highly competitive, rate-making is a complex and highly important aspect of port management. Limits exist to what can be done with port fees and dues, while special services often play a significant role in the port's success.

Rates break down into services for the land carrier (loading and unloading), charges against the cargo (wharfage), and charges against the ship (dockage). The manner in which ports work with carriers is not uniform and tends to vary by and within coastal areas. Despite the fact that dockage and wharfage rates very often are depressed below full costing, the resulting contribution deficits can be more than offset by other profitable port operations, such as handling, warehousing, and industrial leasing and rentals.

Warehousing rates are related to storage rates for the community as a whole. A change in rates is generally subject to regulation by the Interstate Commerce Commission and the state's public utility commission. In practice, the administration of port rates has varied by coastal region. For example, South Atlantic and Gulf Coast ports once quoted "shipside rates" to inland shippers on export or import cargoes. The ports performed carloading or unloading and billed the railroad for this service. Ports also billed for wharfage and the switching of railcars for the benefit of the carrier. These charges were "absorbed" by the railroad and passed on to the shipper. Wharfage charges were also often rebilled to the shipper. Changes in these practices include the billing by Southern ports of shippers directly for wharfage and handling charges, through the terminal to the point where shipper "signs for" the cargo.

In the North Atlantic region, many public terminals are leased to private operators on a flat annual rental; thus, the public port does not enter the picture to any great extent. On the Pacific Coast, ports often do not serve in the role of agent to the carrier, but rather as a "third party" dealing with both land and water carriers. These carriers confer on a joint rate.

It has been noted by some observers that most United States ports operate at a loss, since direct revenues collected do not exceed expenditures. It should be noted that revenues of port authorities are derived from various sources including marine terminal dues, terminal rates, services and charges, rentals and leases, etc. In the case of multipurpose public authorities, earnings from other facilities such as bridges, tunnels and airports may

be reinvested in marine terminals. Where some ports had not been able to generate revenues sufficient to cover both full operational expenses and debt service, political entities have stepped in. Such actions have been based upon the assumption that a modern port creates economic benefits which accrue to the community at large.

Competition among a variety of public institutions for taxpayer financing has supported the trend toward revenue financing. Costs of port projects have increased rapidly in recent years. Public constituencies, facing tax referenda for varied purposes, tend to support enterprises which demonstrate sound, financial management practices. Strengthening of the port's revenue base is a key objective of port management. On a national scale, a sound port industry revenue base is essential to meeting the needs of the nation's waterborne commerce.

In summary, the basic sources of revenue are the rates and charges the port levies on users of its facilities. This schedule of charges is contained in the port tariff, which also includes operating definitions. It is important to realize that all charges, rules, regulations, and practices are instituted to achieve specific goals.

LEASING STRUCTURE

Numerous factors apply to the drafting of port leases. A major consideration is the length of the lease. Leases are either short term (generally defined as from one to ten years), or long term (beyond 10 years).

The advantage of a short-term lease to the port authority is that opportunity exists to take advantage of the law of supply and demand when cargo opportunities are increasing. Also, renewals can take into account escalating costs and land values. A disadvantage of the short-term lease is the potential loss of the tenant when the lease expires. Some ports favor short-term leases for terminal operator tenants, because contracts between terminal operating stevedores and their steamship line

clients are usually of short duration. At most ports, the amount of rental charged is based on current market conditions and competition.

The long-term lease can be of sufficient length to completely amortize the facility. The lease precludes the possibility of the tenant being attracted to another port through a competitive offer. The major disadvantage of the long-term lease is that the rental is fixed throughout the life of the lease.

Port commitment toward unitized cargo handling has continued a trend toward captial intensiveness. Unitized cargo handling includes:

- Containerization.
- Palletizing.
- Crating.
- LASH/SEABEE and roll-on/roll-off vessels.

Improvements in cargo handling technology will address volume demands for unitized cargo in addition to conventional general and bulk cargo. As volume increases, demand will increase for technology designed to reduce hazards and environmental degradation during cargo transfer.

Intermodal transport operations continue to increase the opportunity to utilize carrier experience in advanced technological and administrative procedures for cargo transfer, storage, and reclaim.

A trend toward equipment standardization offers simplification in personnel training and part inventory procedures. This trend is offset to a degree in public ports by required public bidding for purchase of equipment.

REGULATIONS

The federal government bears major responsibility for many activities involving seacoast and Great Lakes port operations:

1. Regulatory activity is administered by the Federal Maritime Commission and the Interstate Commerce Commission.

2. Environmental inspection and regulatory functions are conducted by the United States Environmental Protection Agency and respective state and local agencies.

3. Inspection functions are conducted by Customs, the Public Health Service, the Immigration and Naturalization Service, and the Department of Agriculture.

4. Safety and security activity is the responsibility of the United States Coast Guard and the Occupational Safety and Health Administration.

5. Additional research, advisory and planning activity is conducted by the Federal Maritime Administration and the National Oceanic and Atmospheric Administration.

6. Responsibility for the planning, construction, and maintenance of harbor and channel depths, and the review and issuing of permits for non-Federal development in ports resides with the Corps of Engineers.

(a) Environmental

Environmental considerations play an increasingly important role in determining the scope of port growth and development. Federal legislation designed to minimize port impact on ocean and coastal environments includes:

1. The Clean Air Act with amendment of 1977.

2. Resource Conservation and Recovery Act of 1976.

3. Federal Water Pollution Control Act, as amended by Clean Water Act of 1977.

4. The Rivers and Harbors Act of 1899.

5. Water Research and Development Act of 1978.

6. Water Resources Planning Act of 1965.

7. Fish and Wildlife Coordination Act with amendment of 1965.

8. Ports and Waterways Safety Act of 1972.

9. Noise Control Act of 1972.

10. Coastal Zone Management Act of 1972.

11. Endangered Species Act of 1973.

12. Soil and Water Resources Conservation Act of 1977.

13. Deepwater Port Act of 1974.

14. National Ocean Pollution Research and Development Monitoring and Planning Act of 1978.

15. Marine Protection, Research and Sanctuaries Act of 1972.

16. Outer Continental Shelf Lands Act of 1978.

For example, ports must comply with applicable provisions of federal and state and local government regulations in activities including:

1. Dredging effects on maritime habitats.

2. Dredging material disposal in off-channel, ocean, or land areas.

3. Port facility land use impact on the social and natural environment, including competing water uses.

4. Ship movement and operation, including current turbulence and wave generation, and cargo spills.

Regulations now require environmental impact statements for new construction, expansion, or dredging. The port's ability to respond to short-term economic opportunities may be restricted at the state level due to permit approval time requirements.

(b) Economic Regulations

Regulations address public port agencies as entities of local government. Enabling acts which establish the port authority or commission are tailored to local conditions. The enabling acts usually have basic factors in common:

1. The Port Authority is created as a public trust in the interests of commerce and navigation.

2. The Port Authority is given necessary authorization to engage in those activities necessary for optimum development of the port.

3. Policy is set by a Board of Commissioners.

4. The Board is granted the power of "eminent domain," which empowers it to condemn property for port acquisition.

5. Provision is made for public finance.

Section 205 of the Inland Waterway Revenue Act of 1978 authorized funds for a general study of inland water user charge impacts. A reduced scope of study was approved by Congress during the summer of 1979. The study will focus mainly on the impact of user charges imposed on inland waterways of the United States, particularly the Great Lakes, deep draft channels, and coastal ports. Ports as public agencies are eligible for and have received federal grants. In most cases, federal aid to ports has been through related categorial programs on a project-by-project basis. The Economic Development Administration (EDA) has provided the most federal economic assistance to ports. Approximately $350 million has been provided to local governments for port construction projects since 1966. In several situations, these have served as leverage for additional investments from traditional sources.

EDA offers assistance under programs including:

1. Direct gains of up to 50% for eligible projects in designated areas.

2. Supplementary grants to provide additional assistance for eligible projects in severely distressed areas when applicants cannot supply the local share.

3. Public facility loans in severely distressed areas.

Conventional EDA programs have been supplemented by the Local Public Works Program.

Other agencies that have provided grants for port development include:

- Law Enforcement Assistance Administration.
- Farmers Home Administration.
- Department of Housing and Urban Development.
- Office of Coastal Zone Management.
- Environmental Protection Agency.

(c) Safety

United States Department of Labor and Occupational Safety and Health Administration regulations require periodic inspection of various types of operating equipment and machinery used in terminal operations and stevedoring.

The United States Coast Guard has jurisdiction over hazardous cargo operations in port in addition to fire safety responsibilities for cargo in pier areas. The Coast Guard has additional responsibility for regulation of harbor navigation and traffic control.

Safety programs are ongoing on all coasts through the cooperation of employer and employee organizations. The programs are both promotional and educational, and have produced sound results in terms of decreasing injury rates and reduced lost-time accidents.

Fire protection remains a local responsibility, although proposed federal legislation would provide both planning and implementation grants for port fire control services.

COMPETING USES

Port projects planning using federal funds includes a cost/benefit evaluation for competing uses in addition to environmental considerations. Significant factors of concern include:

1. Transportation savings.

2. Reduction of shipping hazards.

3. Prevention of erosion.

4. Enhancement of land.

5. Provision for recreational facilities and boating.

6. Improvement of commercial and recreational fishing facilities.

7. Environmental Impact Statement preparation.

8. Permit approval for dredging and dredge material disposal.

Competition for use of port facilities includes the effect of changing cargo handling technology, and expansion in vessel size.

SUMMARY

Public ports continue to handle conventional general cargo as well as increasing volumes of bulk and specialized general cargo. Local and state government interest in port activity is a function of port regional economic impact.

Vessel size, traffic volume and type, transportation modes, and land availability are factors which must be considered in assessing the feasibility of port expansion.

Proposed expenditure for new port construction is higher in the Gulf Coast and Pacific Coast for general cargo, while specialized general cargo new construction is higher in the Pacific Coast, North Atlantic, and South Atlantic. Liquid and dry bulk cargo new construction projects are higher for the Gulf Coast, Pacific Coast, and Great Lakes. Trends toward containerization will lead to expansion on sites at coastal areas away from urban areas due to space requirements for terminal and handling services.

Vessel size increases in both domestic and foreign trade will lead to fundamental decisions involving the alternatives of channel dredging or deepwater port development.

Intermodal transportation will continue to provide ports with an opportunity for shared carrier experience in technology and administration.

The impact of carrier rate regulations and environmental regulations, influencing the source, transportation mode selection, and final use of major cargo types is an issue of public policy.

The future of seacoast and Great Lakes ports as competitive public utilities will depend to a great extent upon legislation which will enable ports to respond with reasonable speed and flexibility to economic opportunity.

PROPOSED UNITED STATES PORT CAPITAL EXPENDITURES BY REGION AND FACILITY TYPE (1979-1983)
(Thousands of Dollars)

Region	Conventional General Cargo	Specialized General Cargo	Liquid and Dry Bulk Cargo	Regional Total	Regional Percentage
North Atlantic	$48,105	$170,126	$ 75,334	$ 293,565	9.%
South Atlantic	47,288	170,940	4,887	223,115	7.
Gulf Coast	100,285	135,153	1,723,018*	1,958,456	58.
Pacific Coast	92,593	311,896	294,356**	698,845	21.
Alaska, Hawaii and Puerto Rico	5,993	33,696	0	39,689	1.
Great Lakes	7,397	30,247	120,242	157,886	5.
TOTAL U.S.	$301,661	$852,058	$2,217,837	$3,371,556	100.

NOTES: * Includes Louisiana Offshore Oil Port and Texas Deepwater Port.
** Includes proposed SOHIO Terminal Project in Long Beach, California which has been abandoned since survey was undertaken.

SOURCE: Maritime Administration, United States Port Development Expenditure Survey (1980).

EXHIBIT VIII-2

LEADING TEN PORTS IN PROPOSED EXPENDITURES
FOR CONVENTIONAL GENERAL CARGO FACILITIES (1979-1983)
(Thousand of Dollars)

Port	Total	New Construction	Modernization and Rehabilitation
New Orleans	$31,760	$25,910	$5,850
Georgia Ports	30,657	30,657	-
New York /New Jersey	26,000	25,000	1,000
Houston	21,100	20,000	1,100
Baltimore	17,400	17,400	-
Oakland	16,250	10,250	6,000
Long Beach	16,010	6,500	9,510
Tampa	13,460	13,460	-
Galveston	13,100	11,500	1,600
Los Angeles	13,090	115	12,975

SOURCE: Maritime Administration, United States Port Development Expenditures Survey (1980).

EXHIBIT VIII-3

LEADING TEN PORTS IN PROPOSED EXPENDITURES FOR SPECIALIZED GENERAL CARGO FACILITIES (1979-1983)
(Thousand of Dollars)

Port	Total	New Construction	Modernization and Rehabilitation
New Orleans	$77,404	$61,904	$15,500
Charleston	66,000	66,000	-
New York /New Jersey	64,700	62,700	2,000
Long Beach	62,610	18,760	43,850
Seattle	58,523	57,751	772
Los Angeles	56,546	51,325	5,221
Miami	51,540	51,540	-
Houston	40,249	40,249	-
Oakland	36,250	36,250	-
Wilmington, N.C.	29,400	29,400	-

SOURCE: Maritime Administration, United States Port Development Expenditures Survey (1980).

EXHIBIT VIII-4

LEADING TEN PORTS IN PROPOSED EXPENDITURES FOR BULK CARGO FACILITIES (1979-1983)
(Thousand of Dollars)

Port	Total	New Construction	Modernization and Rehabilitation
Texas Deepwater*	$1,200,000	$1,200,000	$ -
New Orleans	221,500	200,000	21,500
Long Beach**	190,600	146,400	44,200
LOOP*	177,000	177,000	-
Galveston	54,500	54,500	-
Portland, Oregon	39,800	38,000	1,800
New York /New Jersey	39,500	38,500	1,000
Toledo	35,250	35,250	-
San Francisco	35,000	35,000	-
Duluth/Superior	30,000	30,000	-

NOTES: * Offshore Oil Ports.
** Includes estimates for abandoned SOHIO oil terminal project.

SOURCE: Maritime Administration, United States Port Development Expenditures Survey (1980).

GREAT LAKES PORTS
PROPOSED PORT DEVELOPMENT EXPENDITURES (1979-1983)
(Thousands of Dollars)

Port Name	General Cargo Facilities			Specialized General Cargo			Bulk Cargo Facilities			Grand Total
	Total	New	M.R.	Total	New	M.R.	Total	New	M.R.	
New York										
Buffalo	$ 27	$ -	$ 27	$ -	$ -	$ -	$ 5,000	$ 5,000	$ -	5,027
Minnesota										
Duluth/ Superior	-	-	-	-	-	-	30,000	30,000	-	30,000
Silver Bay	-	-	-	-	-	-	2,500	-	2,500	2,500
Wisconsin										
Milwaukee	120	-	120	900	900	-	1,132	370	762	2,152
Illinois										
Chicago	-	-	-	7,500	-	7,500	-	-	-	7,500
Michigan										
Detroit	-	-	-	9,000	9,000	-	-	-	-	9,000
Monroe	-	-	-	-	-	-	660	660	-	660
Ohio										
Cleveland	-	-	-	12,847	-	12,847	-	-	-	12,847
Lorain	-	-	-	-	-	-	10,000	-	18,000	18,800
Toledo	-	-	-	-	-	-	35,250	35,250	-	35,250
Ashtabula	-	-	-	-	-	-	1,800	-	1,800	1,800
Pennsylvania										
Erie	2,000	2,000	-	-	-	-	5,000	-	5,000	7,000
Indiana										
Burns Harbor	5,250	5,250	-	-	-	-	20,900	20,900	-	26,150
TOTAL GREAT LAKES	$7,397	$7,250	$147	$30,247	$9,900	$20,347	$120,242	$92,180	$28,062	$157,886

SOURCE: Maritime Administration, United States Port Development Expenditures Survey (1980).

IX - CONCLUSIONS

This section highlights the primary conclusions of this report. The conclusions are reviewed on a modal basis.

MARINE CARRIERS

Overall, marine carriers will continue the traditional role to transport low-valued bulk commodities between waterside locations.

Higher operating costs associated with more traffic congestion on the waterways and increased, longer-range competition from the railroads will put more pressure on the profitability of carriers and on market share.

Carriers' financial position has eroded somewhat since the 1967-1971 period. More assets are employed now to earn the same amount of after tax profit. A high percentage of carriers' fixed assets are devoted to floating equipment since the right-of-way is publicly provided and shoreside facility needs are minimal. The capitalization of carriers is still strong and their ability to secure necessary financing from the financial community is adequate.

There are several major factors affecting carriers' financial results. One is the rapidly escalating fuel prices. A second is the increased operating costs as a result of increased waterways congestion. Congestion has worsened due to long delays in waterways construction programs and greater regulation of dredging activities. A third factor is the maturing technology. Productivity improvements, long a hallmark of the barge industry, are not occurring in the magnitude they have over prior decades.

Two governmental programs affect the financial position of marine carriers. User charges in their current form levy a fuel tax beginning at four cents per gallon in 1980 and escalating to 10 cents per gallon by 1985. For

the most part, user charges will be passed through to the users of barge services resulting in higher rates. The second program is Title XI financing. It is a government-sponsored program which insures private equipment financing. In many instances the program has been the only viable source for carrier equipment financing.

There are a few economic and technological barriers to greater intermodalism. The primary barriers are institutional. The most important of these is the orientation of carrier management towards a single mode instead of thinking in a total-systems concept.

A number of technology trends are apparent.

1. Increases in vessel capacity.

2. Reductions in port/terminal turn-around time.

3. Improvements in hull design.

4. Improvements in navigation and safety equipment.

5. No radical changes in linehaul equipment.

6. More efficient propulsion systems.

7. Applications of computerized asset management.

8. Increased use of integrated tows on the Great Lakes.

9. More extensive use of integrated tug-barges on domestic ocean service.

RAIL CARRIERS

Overconstruction of rail lines which began in the 1800s still plagues the industry today. These excess lines will be reduced or eliminated as a part of carrier reorganizations or liquidations. The future rail system will consist of fewer route miles and fewer carriers.

The future compositions of the rail industry may be changed as a result of key end-to-end mergers. Likely examples are the Burlington Northern/Frisco, the Family Lines/Chessie, and the Union Pacific/Missouri Pacific. If successful, these mergers could pose important long-term competition for barge lines.

Future capital requirements will be a significant problem for carriers. The Department of Transportation estimates the capital shortfall for the industry between 1976 and 1985 to be approximately $13 billion. This would result in a near-term deterioration in service and rail market share. Much of the projected capital shortfall will be covered by the federal government.

As a result of a more relaxed regulatory environment, railroads will be able to more easily exit or enter markets, and raise rates on a selective basis. Rates will be adjusted more quickly and with greater frequency.

Carriers are placing greater emphasis on marketing and are likely to develop service and pricing packages to meet individual shipper needs. Expanded use of contract rates as a marketing tool is a certainty.

PIPELINES

Future petroleum construction or expansions are likely to be far greater than the two to four percent annual growth in product shipment. A significant new pipeline will carry Alaskan crude from the West Coast to the Midwest. The most likely route for the pipeline is the Northern Tier Pipeline proposal. An important capacity expansion is the Colonial Pipeline in-place pipeline improvements to service the Northeast.

There is one coal slurry pipeline in operation and primary coal-slurry pipeline systems under consideration. The key issues which challenge the future viability of coal slurry pipelines are as follows:

1. Water supply is a critical political issue in the Rocky Mountain states.

2. EPA has concerns over pollution problems of coal slurry water.

3. Most of the proposed slurry lines require eminent domain legislation for their implementation.

4. Railroads have raised the question of need for slurry pipelines.

5. The ability of slurry pipelines to obtain long-term debt financing from private investors is a potential problem.

MOTOR CARRIERS

The relationship of motor carriers to the marine industry is primarily a complementary one. They provide a feeder and/or distributor role to complete marine linehaul shipments. This relationship is particularly important for the commodities of grain and coal.

Limited deregulation of motor carriers, already under way, is likely to result in additional changes to the industry.

1. Increased intercorporate hauling by private fleets.

2. Reduced enforcement of the "common carrier obligation."

3. Rate bureau power would be severely curtailed.

4. Truckload traffic would be deregulated, with lowered rates and increased competition.

5. Less-than-truckload rates would be regulated, but rates could vary within limits.

6. The current Senate bill calls for exemption (from regulation) of all shipments weighing less than 100 pounds.

7. The current Senate bill expands the list of exempt commodities to include, for example, fresh meat.

NATIONAL WATERWAYS STUDY

OVERVIEW OF THE
TRANSPORTATION INDUSTRY

GLOSSARY

1. Anchor Barge - A barge which is permanently moored offshore to coordinate and facilitate the fleeting process.

2. Anchor Fleet - An offshore site at which tows are broken up or formed to meet river conditions and origin/destination points.

3. Backhaul - A movement in the direction of lighter traffic flow when traffic is generally heavier in the opposite direction.

4. Bank Fleet - A site, attached to the shore, at which tows are broken up or formed to meet river conditions and origin/destination points.

5. COFC - Container on flatcar. The transportation of containers without wheels on railcars.

6. Class I Railroad - Railroads having an annual operating revenue of $50,000,000 or more.

7. Collective Ratemaking - A process by which a common rate structure is developed for similar movements by different carriers.

8. Commodity Carrier - (Should be "exempt commodity carrier") - For-hire carriers who haul commodities which are exempt from economic regulation.

9. Common Carrier - A carrier engaged in the business of transporting persons or goods for-hire on an impartial basis.

10. Common Carrier Obligation - The requirement that a common carrier provide service to all shippers.

11. Containerized - A cargo shipping method which uses large standard size containers to unitize cargo and reduce cargo handling time as the shipment is moved between modes.

12. Contract Carrier - A carrier whose authority is limited to transporting freight or passengers under contracts between the carrier and the shipper.

13. Contract Rates - Linehaul transport rates which are agreed upon between a shipper and a carrier for a specified move.

14. Covered Hopper - A type of barge in which dry bulk commodities susceptible to weather damage (e.g., grains) are transported.

15. Deck Barge - A type of barge used primarily for transporting waterways materials (e.g., rip rap, piling, etc.) or heavy equipment on the deck of the barge.

16. Draft - The depth of water necessary to float a vessel.

17. Fleet or fleeting area - the location at which fleeting operations occur.

18. Fleeting - The breakup and consolidation of barges to form a tow with proper operating characteristics for the river segments to be travelled (e.g., draft, turning radius) and with common destinations.

19. For-Hire Carriers - Carriers who transport freight belonging to others (as opposed to private carriers).

20. Foreign Trade Zone - An area within a country where imported goods are exempt from custom duties. Duties are only applied when the goods are removed from the foreign trade zone for use or consumption within that country, and duties are applied only to the value of the goods which were imported to the foreign trade zone, not to the value added by any processing or fabricating.

21. Fronthaul - The movement of goods in the direction of the heavy traffic flow.

22. Integrated Tow - Tows which carry high volumes of traffic, often on a dedicated basis, between specific points.

23. Integrated Tug-Barge - Various designs for a towboat and barge have been developed to permit the two when properly coupled to behave in seas as if they were a single vessel unit.

24. Interlining - The transfer of equipment containing freight from one carrier to another as part of one origin/destination movement.

25. LASH - A lighter aboard ship is a vessel designed to transport barges, which, in turn, have smaller dimensions than jumbo barges. These barges are single skin barges. Barges are loaded or offloaded by means of a stern ramp.

26. LOOP - Louisiana Offshore Oil Port - An offshore oil port designed to receive crude petroleum by VLCC (very large crude carriers) and ship petroleum by pipeline to storage tanks or refineries located onshore.

27. LTL - Less than truckload. Movement of freight in quantities which do not comprise a full truckload (i.e., less than 40,000 pounds.

28. Lightering - Partial unloading (or offloading) of a vessel to another to reduce the vessel's draft.

29. Linehaul - The transport of freight over long distances.

30. Linehaul Railroad - Railroads which carry freight over long distances.

31. Load Center - A large port with modern handling equipment which can serve an entire region.

32. MAP - Mid-America Ports Study conducted by the Maritime Administration.

33. Midstreamer Industry - A specialized service industry which has developed to provide fuel and other expendable supplies to linehaul operators while the tow is under way.

34. Notched Barge - A specially designed barge which has an indentation in the stern for the insertion of the bow of a power vessel, thus reducing the effect of wave actions on the tow.

35. Open Hopper - A type of barge in which dry bulk commodities not susceptible to weather damage (e.g., coal, rock, etc.) are transported.

36. PDES - Port Development Expenditure Survey conducted by the Maritime Administration.

37. Payload - The amount of cargo transported by a carrier.

38. Piggyback Service - A linehaul movement in which a container or trailer is carried on a railcar.

39. Private Carriage - Movement of freight by a carrier which is a captive transport arm of a producer or retailer.

40. RoRo - Roll-on, roll-off vessels are designed to receive or ship cargo (through a stern quarter ramp) loaded on wheels.

41. Raft - The mass which is formed by binding together logs for river transport.

42. Rail Siding - A length of track built parallel to the main track and connected to the main track at both ends.

43. Rate Bureau - An organization of rail carriers which sets common rates for the transport of commodities.

44. Right-of-Way - The transport routes available to a carrier.

45. SEABEE - This is a trade name for barges and vessels designed for and operated by Lykes Lines. The vessel is designed to load or offload barges by use of a stern ramp. SEABEE barges are double skin.

46. Self-unloader - A barge which has the mechanical capability to unload without port unloading equipment.

47. Single Cargo Facility - A terminal which handles only one cargo type (e.g., only liquid bulk).

48. Slurry System - A pipeline system for the transport of commodities suspended in a transport liquid.

49. Spot Rates - A rate which is charged for a single move, as opposed to a contract rate which covers multiple moves over a time period.

50. Subchartering - The commission of a second carrier by the primary carrier to handle some portion of a move for which the primary carrier originally contracted.

51. Switching and Terminal Companies - Companies engaged in the business of railcar switching or trans-loading and storage.

52. TOFC - Trailer on flatcar. The transport of truck trailers on railcars.

53. Tandem Trailers - Two trailers which are linked and transported together.

54. Tank Barge - A type of barge used for transporting liquid bulk cargo.

55. Tow - Individual barges lashed together into a single unit.

56. Unit Train - A dedicated movement of one type of transportation equipment between two specific points with no stopping in-between for adding or subtracting cars from the train.

57. Unitized Cargo - The combination of several packages so they can be moved as one unit. Common methods include the use of pallets, slip sheets, shrink wrap, etc.

58. User Charges - A fee which is charged for the use of the inland waterways facilities.

59. VLCC - Very Large Crude Carriers. Large ocean-going crude oil carriers.

60. Value of Service Ratemaking - A system of setting rates which charges more for shipping higher value goods than for lower value goods.

61. Way Train - A train which moves between two points with many intermediate stops for dropping off or adding cars to the train.

OVERVIEW OF THE TRANSPORTATION INDUSTRY BIBLIOGPAPHY

For organizational purposes, bibliography sources are grouped in the following categories:

- General Sources
- Inland Waterways
- Inland Ports and Terminals
- Domestic Ocean
- Ocean Ports and Terminals
- Competitive Modes: Railroads
- Competitive Modes: Pipelines
- Waterway User Charges
- Waterborne Trade: Present and Future
- Water Transport Equipment
- Intermodalism
- Selected Commodity Analyses
- Ports: General

NOTE: Sources have been purposely limited to those published during the current decade in order to minimize out-of-date material.

GENERAL SOURCES

A. T. Kearney, Inc. The Fourth Seacoast - United States Great Lakes-Seaway Port Development and Shipper Conference - Dearborn, Michigan, April 25-29, 1979. Springfield, Virginia: National Technical Information Service, August, 1976.

Adams, G. H. Freight Travel Time (A Bibliography with Abstracts). Springfield, Virginia: National Technical Information Service, January, 1976.

Campbell, E. W. New York State Department of Transportation. "The State's Role in Waterborne Transportation." New York, New York: American Society of Civil Engineers, Proceedings - 1977.

Current Transportation Issues in the United States: Volume I: Executive Summary. Washington, D.C.: National Transportation Policy Study Commission, 1978.

Great Lakes Red Book - Annual Directory. St. Clair Shores, Michigan: Fourth Seacoast Publishing Company, Inc.

Hendrix, F. L. Tennessee University, Knoxville. "Marketing Waterborne Transportation." New York, New York: American Society of Civil Engineers, Proceedings - 1977.

MARAD 1977 Annual Report. Report of the Maritime Administration for Fiscal Year 1977, May 1978.

National Energy Transportation: Volume I - Current Systems and Movements. United States Senate Committee on Commerce, Science, and Transportation, 1977.

National Transportation Statistics - Annual Report. United States Department of Transportation, September, 1977.

National Transportation Trends and Choices (To the Year 2000). United States Department of Transportation, Washington, D.C., 1977.

Phillips, C. Cost-Efficient Cargo Distribution Among Transportation Modes. College Station, Texas: Texas A&M University, March 1976.

Practical Applications of Space Systems: Marine and Maritime Uses. National Academy of Sciences, Washington, D.C., 1975.

1977 Waterside Site Plant Locations and Expansions. Annual Report. Arlington, Virginia: American Waterways Operators, Inc., 1978.

INLAND WATERWAYS

Barloon, M. J., Case Western Reserve University. United States Shallow-Draft Inland Waterway Transportation: Productivity and Policy. Washington, D.C.: National Environmental Development Association, June, 1978.

Brazos River Authority Report on Economic Impact and Traffic Evaluation Study of Barge Navigation on the Brazos River. Waco, Texas: Brazos River Authority; Baton Rouge, Louisiana: Economic Development Administration, October, 1975.

Broemser, G. M. "Role of Waterways in the Nation's Transportation System." Washington, D.C. Transportation Research Board, Record No. 545, 1975.

Bronzini, M. S., Georgia Institute of Techonology. "Optimal Cargo Vehicle Flow Patterns for Inland Waterway Systems." Washington, D.C: Transportation Research Board, Record No. 577, 1976.

Brooks, W. A. and Metzner, H. E., Missouri University, Rolla; and Smith, M. L., Jr., Phillips Petroleum Company, "A Model for Cost Optimization of Barge Shipments." Chicago, Illinois: Transportation Journal, American Society of Traffic and Transportation, 1978.

Carroll, J. L.; Rao, S.; Wilson, H. G., Pennsylvania State University, University Park, Alternative Method for Increasing the Efficiency of the Inland Waterways. New York, New York: Society of Naval Architects and Marine Engineers, 1974.

Carroll, J. L., and Rao, S., Pennsylvania Transportation Institute. "Economics of Public Investment in Inland Navigation: Unanswered Questions." Chicago, Illinois: Transportation Journal, American Society of Traffic and Transportation, 1978.

Factors To Be Considered in Setting Future Policy for Use of Inland Waterways. Washington, D.C.: United States General Accounting Office, 1975.

Haefner, L. E., Washington University, St. Louis; Dye, W. "Locks and Dam 26: A Dilemma In National Transportation." Washington, D.C.: Transportation Research Record, Transportation Research Board, 1978.

Hall, Gunnar; Branyan, Charles O.; Mickle, George D.; Kester, Rodger P.; Harr, Herbert R., Jr. "Waterborne Commerce and Inland Port Development." Transportation Research Board, Record No. 669, 1978.

Hoffmeister, J. F., III, and De Neufville, R. "Optimizing Supply of Inland Water Transport." New York, New York: ASCE Journal of Waterways, Harbors and Cost Engineering Division, American Society of Civil Engineers, August, 1973.

Inland River Guide Annual Directory. St. Louis, Missouri: Waterway Journal, Inc.

Kent, T. A.; Army Engineering Division, Cincinnati. Framework Plan for Ohio Basin Navigation to 2020. New York, New York: ASCE Journal of Waterways and Harbors Division, American Society of Civil Engineers, August, 1970.

Lowry, P. R., Memphis State University; Goodwin, W. A., Tennessee Department of Transportation. "State Management of Inland Waterways Port Development. Washington, D.C.: Transportation Research Board, Record No. 620, 1976.

Miloy, John and Phillips, Christian, Texas A&M University. Primary Economic Impact of the Gulf Intercoastal Waterway in Texas. Sea Grant Program, 1974.

Opportunities for Large Savings by Altering Some Inland Waterway Operations. Washington, D.C.: General Accounting Office, Community and Economic Development Division, 1977

Recommendation for River-Related Economic Development of Missouri. Missouri Department of Transportation, September, 1978.

River Transportation in Iowa. Iowa Department of Transportation, May, 1978.

"The Role of American Waterways in Sustaining United States Industrial Strength," Remarks by William R. Roesch, Executive Vice President, United States Steel Corporation, September, 1978.

Roy, L. A. "Financial Needs of the United States Inland Waterways System: Prospects and Profile." New York, New York: American Society of Civil Engineers, Proceedings, 1977.

Tennessee's Opportunities on Its Waterways System. Memphis, Tennessee: Memphis State University; Knoxville, Tennessee: Tennessee University, November, 1974.

Waterways Investments Guide: Arkansas, Kansas, Louisiana, Missouri, and Oklahoma. Little Rock, Arkansas: Ozarks Regional Commission, 1978.

INLAND PORTS AND TERMINALS

A. T. Kearney, Inc. Study of the Port of Metropolitan St. Louis. Volume 1. A Primer on Inland Waterways Ports. Springfield, Virginia, National Technical Information Service, March, 1977.

A. T. Kearney, Inc. _Study of the Port of Metropolitan St. Louis_. Volume 2. _Executive Summary_. Springfield, Virginia, National Technical Information Service, March, 1977.

A. T. Kearney, Inc. _Study of the Port of Metropolitan St. Louis_. Volume 3. Appendix A. _Profile of the Port_. Springfield, Virginia, National Technical Information Service, March, 1977.

A. T. Kearney, Inc. _Study of the Port of Metropolitan St. Louis_. Volume 4. Appendix B. _Commodity Market Analysis_. Springfield, Virginia, National Technical Information Service, March, 1977.

A. T. Kearney, Inc. _Study of the Port of Metropolitan St. Louis_. Volume 5. Appendix C. _Port Operations Analysis_. Springfield, Virginia, National Technical Information Service, March, 1977.

A. T. Kearney, Inc. _Study of the Port of Metropolitan St. Louis_. Volume 6. _Atlas_ (Microfiche only). Springfield, Virginia, National Technical Information Service, March, 1977.

A Study of River Ports and Terminals. Carbondale, Illinois: Southern Illinois University, June, 1968.

Directory of Regional Port Districts in Illinois. Illinois Department of Transportation - Division of Water Resources, July, 1978.

Ernst and Ernst. _Improving Productivity for Bulk Commodity Transfer Facilities in the Great Lakes Trade Area_. Prepared for Maritime Administration, United States Department of Commerce, April, 1979.

Final Environmental Statement: Rail-To-Barge Coal Transfer Facility, St. Louis, Missouri. St. Louis, Missouri: Department of Defense, July, 1976.

The Gulf Intercoastal Waterway in Texas--1976. Austin, Texas: Texas State Department of Highways and Public Transportation; Transportation Planning Division, 1976.

Gulf South Research Institute. Small Port Development Potentials in North Louisiana. Prepared for Economic Development Administration, 1971.

Hazard, J. L.; Michigan State University, East Lansing. Inland Waterway Ports as Intermodal Freight Centers. Washington, D.C.; Transportation Research Board Publications Office, 1978.

Proposed Municipal Barge Terminal. The Davenport Levee Improvement Commission, June, 1973.

Richards, P. R. Public Port Financing in Texas: An Overview of Current Practices, Alternatives, and Future Needs. Galveston, Texas: Texas A&M University; Center for Marine Resources, Austin, Texas; Texas Coastal and Marine Council, December, 1976.

Tippetts-Abbett-McCarthy-Stratton. Mid-American Ports Study. Prepared for Maritime Administration, United States Department of Commerce, 1979.

United States Army Corps of Engineers, Ohio River Division. River Terminals Ohio River and Tributaries. May, 1974.

Wisconsin's Great Lake Ports: Alternative State Policy Options. Wisconsin Department of Transportation, May, 1976.

Yewell, J.; Oglebay Norton Company. Licking River Terminal: A Showcase in Coal Handling. Chicago, Illinois: Coal Mining and Processing; Maclean-Hunter Publishing Corporation, October, 1978.

DOMESTIC OCEAN

Matson Research Corp. Trans-Ocean Tug-Barge Systems. Prepared for United States Department of Commerce, Maritime Administration, 1970.

Kyle, B. Maritime Administration. Domestic Waterborne Commerce, Its Role and Future. New York, New York; Society of Naval Architects and Marine Engineers, May, 1974.

Status Report of the Second National Conference on Domestic Shipping. Washington, D.C.: Maritime Administration, Department of Commerce, June, 1978.

University of Delaware. A Case Study of a Comprehensive Marine Transportation System for the Delaware Valley Region. Prepared for the National Oceanic and Atmospheric Administration, May 1977.

OCEAN PORTS AND TERMINALS

Aerospace Corporation. Port System Study for the Public Ports of Washington State and Portland, Oregon. Volume 1. Overview. Springfield, Virginia, National Technical Information Service, March, 1975.

Aerospace Corporation. Port System Study for the Public Ports of Washington State and Portland Oregon. Volume 2, Part 1 - Study Approach, Commodity Specifications, Trend Analysis & Domestic Trade Origin and Destination Data. Springfield, Virginia, National Technical Information Service, March, 1975.

Aerospace Corporation. Port System Study for the Public Ports of Washington State and Portland Oregon. Volume 2, Part 5 - Maritime Port Technology Forecasts and Demand Analysis. Springfield, Virginia, National Technical Information Service, March, 1975.

Boerger, Frank C. Port Requirements for the San Francisco Bay Area - Phase I Summary Report. Prepared for the Maritime Administration, United States Department of Commerce, July 1976.

Coverdale & Colpitts. Florida Waterport System Study - Volume I through Volume VII. Prepared for Florida Department of Transportation, Florida Ports Council, and United States Maritime Administration, 1978.

Frankel, Ernst. Studies on the Future of Atlantic Ports. Cambridge, Massachusetts: Massachusetts Institute of Technology, July, 1973.

Nathan Associates, Inc. United States Deepwater Port Study. Prepared for United States Army Corps of Engineers, August, 1972.

Observations on American Seaports--Importance, Developmental Constraints, and Future Implications. Washington, D.C.: Department of the Navy, May, 1979.

Office of Port and Intermodal Development. Economics of Deepwater Terminals. Washington, D.C.: Maritime Administration, United States Department of Commerce, January, 1972.

Policy Planning Consultants. Manual of Traffic Studies for Marine Container Terminals Washington, D.C.: United States Government Printing Office, October, 1974.

Policy Planning Consultants and Manalytics, Inc. Regional Port Planning Study for San Francisco Bay Area. Springfield, Virginia, National Technical Information Service, September, 1976.

Reid, Middleton & Associates, Inc. Port System Study for the Public Ports of Washington State and Portland, Oregon. Volume 2, Part 6 - Port Capacity Analysis and Methodology. Springfield, Virginia, National Technical Information Service, March, 1975.

Soros Associates, Inc. Offshore Terminal System Concepts. Springfield, Virginia, National Technical Information Service, July, 1972.

United States Army Corps of Engineers. Atlantic Coast Deepwater Port Facility Study. North Atlantic Division, June, 1973.

United States Army Corps of Engineers. West Coast Deepwater Port Facilities Study. North and South Pacific Divisions, June, 1973.

United States Department of Transportation. Atlantic Coast Deepwater Port Study. Washington, D.C., July, 1978.

COMPETITIVE MODES: RAILROADS

Ainsworth, D. P., Keale, M. J., and Riker, J. B. National Intermodal Network Feasibility Study. Executive Summary. Greenwich, Connecticut: Reebie (Robert) & Associates, Inc., September, 1975.

ConRail B-Modal and Inter-Modal Operations. Route Structure Based Upon Penn Central, Lehigh Valley, and Central of New Jersey Railroads. Greenwich, Connecticut: Reebie (Robert) & Associates, Inc.; and Washington, D.C.: United States Railway Association, August, 1975.

DeBoer, D. J., Federal Railroad Administration. "The Future of TOFC and COFC." Chicago, Illinois: Railway Management Review, Railway Systems and Management Association, 1972, pp. A66-A70.

Due, J. F., University of Illinois, Urbana. "The Railway Industry - Where Next?" White Plains, New York: Challenge, International Arts and Sciences Press, Inc., November, 1976.

Federal Aid to Railroads - Financial Assistance to Railroad Retirement. Jesse J. Friedman & Associates, April, 1978.

<u>Federal Aid to Railroads - Government Capital Assistance Programs</u>. Jesse J. Friedman & Associates, January, 1979.

Grygiel, J. A.; Atchison, Topeka and Santa Fe Railway. <u>Problems at the Interface. A Rail Viewpoint</u>. London: <u>ICHA Journal</u>; International Cargo Handling Association, September 1973.

<u>Materials Concerning the Effects of Government Regulation on Railroads and an Economic Profile of Railroads in the United States</u>. Washington, D.C.: United States House of Representatives; Committee on Interstate and Foreign Commerce, December, 1975.

Moses, L. N. <u>Productivity in Transportation and Piecemeal Deregulation of the Industry</u>. Evanston, Illinois: Northwestern University, April, 1975.

<u>Rail Rate Equalization</u>. Washington, D.C.: Interstate Commerce Commission, Rail Service Planning Office, January, 1979.

<u>Rail Rate Equalization To and From Ports</u>. Washington, D.C.: Interstate Commerce Commission, January, 1979.

Reebie, R. S., Ainsworth, D. P., Liba, C. J., Riker, J. B., Keale, M. J., Urba, C. E., Isacowitc, D. A., and Laughlin, M. O. <u>National Intermodal Network Feasibility Study. Appendices 1 through 4 - Part II</u>. Greenwich, Connecticut: Reebie (Robert) & Associates, Inc.; and Washington, D.C.: Peat, Marwick, Mitchell and Company, May, 1976.

Robert Reebie & Associates, Inc. <u>An Evaluation of Alternative Railroad Terminal Container Handling Systems</u>. Springfield, Virginia: National Technical Information Service, April, 1971.

Statements From Senate Surface Transportation Subcommittee on the Rail Deregulation Bill. May, 1979.

Sward, J. D. Unitrain Operating Methods and Costs. Ann Arbor, Michigan: Michigan University, and Department of Naval Architecture and Marine Engineering, July, 1973.

Systems Engineering for Intermodal Freight Systems--Phase I, Exploratory Planning, Volume I--Executive Summaries. Washington, D.C.: A. T. Kearney, Inc., Office of Research and Development; Peat, Marwick, Mitchell and Company; Federal Railroad Administration, April, 1978.

Walsh, D. A.; Cunliffe; J. P. Rail Facilities for a Major Port - The Los Angeles Example. New York, New York: American Society of Mechanical Engineers, 1976.

COMPETITIVE MODES: PIPELINES

American Petroleum Institute, A Formal Critique of the Justice Department's Pipeline Undersizing Assertion, August 2, 1978.

American Petroleum Institute, Fact Sheet: United States Oil Pipeline Industry, December, 1978.

American Petroleum Institute, Integration and Joint Ventures in Pipelines, September 8, 1977.

American Petroleum Institute, National Concentration Measure in the Interstate Oil Pipeline Industry, June 10, 1976.

American Petroleum Institute, Oil Pipelines: Industry Structure, November, 1978.

American Petroleum Institute, Pipeline Transport of Highly Volatile Liquids, May 15, 1979.

American Petroleum Institute, Pipelines and Antitrust, November, 1978.

Association of Oil Pipelines, Pipelines Continue to Lead All Other Forms of Transport in Movement of Oil in 1976, June 19, 1978.

Chicago Tribune, Midwest Thirsts for West-East Oil Pipelines, August 19, 1979.

Colonial Pipeline Company, Performance and Trends, December, 1978.

Energy Transportation Systems Inc., Coal Slurry Pipeline: A Summary of Environmental and Consumer Benefits, November, 1974.

Forbes, The Water Crisis: It's Almost Here, August 20, 1979.

Hudson Institute, Research Analysis of Factors Affecting Transportation of Coal by Rail and Slurry Pipeline, April, 1976.

Journal of Commerce, Rails Evolving Strategy to Block Coal Slurry Pipeline Industry, July 23, 1978.

Lennart, R. P., Pipeline Orientation Speech: Amoco Oil Company, July 24, 1978.

Maritime Administration, A Preliminary Feasibility Study of Steam Coal Slurry Marine Transport Systems, April, 1977.

Maritime Transportation Research Board, Critical Issues in Coal Transportation, November 1977.

Office of Technology Assessment, A Technology Assessment of Coal Slurry Pipeline, March 1978.

Oil & Gas Journal, Alternatives Are Studied for Moving Coal by Pipeline, August 27, 1979.

Richardson, L., Coal Slurry Pipelines: Issues and Problems, Public Utilities Fortnightly, August 16, 1979.

Slurry Transport Association, Promotional Pamphlets: "How Coal Slurry Pipelines Protect the Environment and Community Life," "How Coal Slurry Pipelines Safeguard Water Resources," "How Coal Slurry Pipelines Save Consumer Dollars," "How Coal Slurry Pipelines Work for Your Benefit," December, 1978.

United States Federal Power Commission, National Gas Survey: Volumes I-V, 1973.

WATERWAY USER CHARGES

A Study of the Inland Waterway Use Charge Program. Cambridge, Massachusetts: Charles River Associates, Inc., December, 1970.

Anderson, D. L., Schuessler, R. W., Cardellichio, P. A. Regional Market, Industry, and Transportation Impacts of Waterway User Charges. Cambridge, Massachusetts: Transportation Systems Center, August, 1977.

Anderson, D. L., Schuessler, R. W., Cardellichio, P. A. Modal Traffic Impacts of Waterway User Charges. Volume I: Recovery Options and Impacts Summary. Cambridge, Massachusetts: Transportation Systems Center, August, 1977.

Anderson, D. L., Schuessler, R. W., Cardellichio, P. A. Modal Traffic Impacts of Waterway User Charges. Volume II: Distribution Systems Analysis. Cambridge, Massachusetts: Transportation Systems Center, August, 1977.

Anderson, D. L., Schuessler, R. W., Cardellichio, P. A. Modal Traffic Impacts of Waterway User Charges. Volume III: Data Appendix. Cambridge, Massachusetts: Transportation Systems Center, August, 1977.

Ashton, P. M., Department of the Environment, Canada; Cooper-Ruska, C., and Shabman, L. A. Legal-Historical Analysis of Navigation User Charges. New York, New York: ASCE Journal of Water Resources, Planning Management Division, April, 1976.

Bronzini, M. S., CACI, Inc.; Hawnn, A. F. and Sharp, F. M., Department of the Army. "Impacts of Inland Waterway User Charges." Washington, D.C.: Transportation Research Record, Transportation Research Board, 1978.

Carroll, J. L., Rao, S., and Wilson, H. G., Pennsylvania State University, University Park. Alternative Method for Increasing the Efficiency of the Inland Waterways. New York, New York: Society of Naval Architects and Marine Engineers, June, 1974.

Case, L. S., Carnegie-Mellon University; and Lave, L. B. Tolls: Efficiency and Equity Issues for Inland Waterways. Providence, Rhode Island: Management Science, Institute of Management Science, April, 1977.

"The Comenici Cost-Recover Waterway User Charge Proposals and the Disruption of the Competitive Structure of United States Transportation." 205 Studies, August, 1977.

Cooper-Ruska, C. User Charges in Inland Navigation Policy. Blacksburg, Virginia: Virginia Polytechnic Institute and State University; and Washington, D.C.: Department of the Interior, Office of Water Research and Technology, August, 1974.

The Effects of Inland Navigation User Charges on Barge Transportation of Wheat. Virginia Polytechnic Institute and State University, Blacksburg; Purdue University, Lafayette, Indiana; Department of Agricultural Economics, Office of Water Research and Technology, Washington, D.C., 1978.

Ernst and Ernst. Impact of User Charges Applied to Inland Waterways. Washington, D.C.: Prepared for United States Maritime Administration, December, 1976.

Gladders, T. L. "The User Charge and Locks and Dam 26 Constraint Issues--The View of the Barge and Towing Industry." Washington, D.C.: Transportation Research Board, Record No. 669, 1978.

Impacts of a Waterways User Charge on the Economy of Tennessee. Memphis State University, Bureau of Business and Economic Research, May, 1978.

Iowa Department of Transportation Staff Waterway User Charge Proposal. Ames, Iowa: Iowa Department of Transportation, September, 1976.

Johnson, J. W., St. Cloud State University, Minnesota, and Berger, D. L., Tulsa University. "Waterway User-Charges: An Economic and Political Dilemma." Chicago, Illinois: Transportation Journal, American Society of Traffic and Transportation, 1977.

"Research Guide - Inland Waterways Revenue Act of 1978." Section 205 Studies, 1978.

Shabman, L. A. User Charges for Inland Waterways: A Review of Issues in Policy and Economic Impact. Blacksburg, Virginia: Virginia Polytechnic Institute and State University, Virginia Water Resources Research Center, May, 1976.

"Waterway User Charges: Is it in the Railroads' Self-Interest?" Remarks of John A. Creedy, President, Water Transportation Association, March, 1978.

"Why Should Congress Analyze the Prospective Impact of User Charges . . . Before Enacting Such Charges?" Testimony of Professor Marvin J. Barloon before the Water Resources Subcommittee, April, 1977.

WATERBORNE TRADE: PRESENT AND FUTURE

Policy Planning Consultants. Trade Outlook of the Northern California Ports: Year 2000 and Beyond. Prepared for Maritime Administration, United States Department of Commerce, November, 1975.

Policy Planning Consultants. Trade Outlook of the Puget Sound Ports to Year 2000. Prepared for Port of Seattle Planning and Research Department, 1977.

Summary Report: Projecting the Demand for Ohio River Basin Waterway Traffic Using Correlation and Regression. Prepared for United States Army Corps of Engineers by CONSAD Research Corporation, January, 1979.

United States Department of Commerce, Maritime Administration. A Long-Term Forecast of United States Waterborne Foreign Trade 1976-2000. Washington, D.C., November, 1977.

1975 Inland Waterborne Commerce Statistics. The American Waterways Operators, Inc., April, 1977.

WATER TRANSPORT EQUIPMENT

Central Region Office of Port and Intermodal Development. Listing of Barges Specially Designed to be Carried Aboard Another Vessel. Washington, D.C.: Maritime Administration, United States Department of Commerce, April, 1978.

Cove, D. S., Cove, Hatfield and Company, Limited. Development of Bulk Petroleum Barges on the Canadian West Coast. London: North American Tug Convention, May, 1973.

Exploratory Study of Adapting or Developing Collapsible Containers and Inter-Liners for Use in Specialized Rail and Barge Equipment. Camp Springs, Maryland: Snitzler (James R.) and Associates, Inc., 1978.

Office of Port and Intermodal Development. Inventory of American Intermodal Equipment. Washington, D.C.: Maritime Administration, United States Department of Commerce, April, 1978.

Oliver, N. D. The Energy Requirements for the Movement of Coal by Barge. Cambridge, Massachusetts: Massachusetts Institute of Technology, Department of Ocean Engineering, August, 1976.

Slager, J. J.; Gyves, S. N.; Lain, H. W.; and Poquette, G. M. Conceptual Studies and Preliminary Design of a 300-Ton Capacity Cargo Transporter Barge. Laurel, Maryland: Hydronautics, Inc., December, 1971.

INTERMODALISM

Alexander, N. J. B. Railways and Their Interaction with Ports. London: International Cargo Handling Coordination Association, July, 1978.

Central Region Office of Port and Intermodal Development. Container Transfer Report for the Port of Houston. Washington, D.C.: Maritime Administration, United States Department of Commerce, December, 1976.

Computer Sciences Corporation. Intermodal Cargo Control System for the Port of San Francisco. Springfield, Virginia, National Technical Information Service, August, 1973.

Howard, F. H., International Containers, Ltd.; Hennessey, W. F., Atchison, Topeka and Santa Fe Railway; Welter, L. J.; and Shimrak, G., Penn Central Transportation Company. "Mini-Bridge Forum." Chicago, Illinois: Railway Management Review, Railway Systems and Management Association, 1972, pp. A50-A65.

"Imports 'Land-Bridged' to Canada Held Outside Economic Regulation." Washington, D.C.: Traffic World, Traffic Service Corporation, December, 1975, p. 21.

"Intermodalism with a Purr." New York, New York: Port Authority of New York and New Jersey. November, 1977, pp. 4-5.

Lang, D., Jr.; Land, D. E., Civic Systems, Inc.; and Wuenscher, D., Real Estate Analysis, Ltd. "Local and Regional Socioeconomic Impact of the Intermodal Freight Transportation Facilitation Center." Washington, D.C.: Transportation Research Record; Transportation Research Board, 1978.

Lawless, R. E., Canadian National Railways; Reebie, R. S.; Margolin, E., Interstate Commerce Commission; and Ogle, P. E., O-T-D Corporation. "When Will Domestic Containerization Take Off?" Chicago, Illinois: Railway Management Review, Railway Systems and Management, 1972, 23 pages.

Moser, D. E. Intermodal Transportation and Distribution Systems for Moving Grain and Fertilizer. Washington, D.C.: Department of Agriculture; Cooperative State Research Service, August, 1978.

National Cargo Bureau. Shippers Guide for Proper Stowage of Intermodal Containers with Emphasis on Ocean Transport. Maritime Administration, United States Department of Commerce, 1970.

Norris, J. T., Jr., Department of Transportation. "Minibridge in Focus." Chicago, Illinois: Railway Management Review, Railway Systems and Management Association, 1972, pp. A39-A42.

Progress in Cargo Handling, Volume 6. London: International Cargo Handling Coordination Association, 1975.

Ramsey, S. P.; Carter, S.; Kososki, J.; Cristoff, J. W. Des Moines to Keokuk Rail/Barge Study. Des Moines, Iowa: Iowa Department of Transportation, September, 1977.

Robert Reebie & Associates. Relationship of Land Transportation Economics to Great Lakes Traffic Volume. Springfield, Virginia: National Technical Information Service, November, 1971.

Roseman, D. P., Hydronautics, Inc.; Anderson, A. K., Marconaflo, Inc.; and Lisnyk, J., Maritime Administration. Marine Transport of Bulk Commodities in Slurry Form - An Assessment. New York, New York: Society of Naval Architects and Marine Engineers.

Schrier, E., President, Manalytics, Inc. "Maritime Container Transportation Trends." Chicago, Illinois: Railway Management Review, Railway Systems and Management Association, 1972, pp. A1-A20.

Seguin, V. C., Union Carbide Corporation. "Containers for Domestic Freight - What Do the Carriers Think?" Chicago, Illinois: Railway Management Review, Railway Systems and Management Association, 1972, pp. A92-A98.

Smith, C. Rail and Barge Transportation or the Reversal of the Winning of the West. San Francisco, California: PLM, Inc., 1977.

Sunkel, R. E., "Intramodalism vs. Intermodalism." Containerization International, National Magazine Company Limited, Volume 10, December, 1976 pp. 17-19.

"Two New Micro-Bridge Tarrifs at FMC Show Separate Rail/Ocean Division." Jacksonville, Florida: American Shipper, Howard Publications, Inc., December, 1976, pp. 30-31.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface at the Port of Baltimore. Springfield, Virginia: National Technical Information Service, April, 1974.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface at the Port of Charleston. Washington, D.C.: United States Government Printing Office, June, 1975.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface at the Port of Hampton Roads. Washington, D.C.: United States Government Printing Office, June, 1975.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface at the Port of Jacksonville. Washington, D.C.: United States Government Printing Office, August, 1975.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface at the Port of New Orleans. Washington, D.C.: United States Government Printing Office, September, 1974.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface at the Port of New York. Washington, D.C.: United States Government Printing Office, April, 1973.

United States Department of Commerce, Maritime Administration. Report on Rail and Marine Interface in the San Francisco Bay Area. Washington, D.C.: United States Government Printing Office, September, 1974.

Velez, R. A., Seatrains Lines. "A Land Bridge - The Myth and the Reality." Chicago, Illinois: Railway Management Review, Railway Systems and Management Association, 1972, pp. A43-A49.

Vickers, P. F. "Intermodal Aspects of Container Service." Intermodal World Inc., Transport 2000, 1977, pp. 26-28.

SELECTED COMMODITY ANALYSES

Coal Transportation Capability of the Existing Rail and Barge Network, 1985 and Beyond. Palo Alto, California: Electric Power Research Institute, EPRI Records and Reports Center, 1977.

Creelman, William A., National Marine Service, Inc. The Transportation of Refrigerated Anhydrous Ammonia on the Inland Waterways. New York, New York: Marine Technology, January, 1971.

Desai, S. A. Water Transportation Requirements for Coal Movement in the 1980's. Cambridge, Massachusetts: Input-Output Computer Services, Inc.; and Transportation Systems Center, December, 1976.

Edwards, E. F.; Dravo Corporation and Zachariason, R. A. Rail-to-Barge Transportation of Coal. New York, New York: American Society of Mechanical Engineers, 1978.

Gasohol from Grain - The Economic Issues. Washington, D.C.: Economics, Statistics, and Cooperative Service; Committee on the Budget (United States House); and Task Force on Physical Resources, January, 1978.

Larwood, G. M., and Benson, D. C. Coal Transportation Practices and Equipment Requirements to 1985. Washington, D.C.: Bureau of Mines, 1976.

Martinka, P. D., American Electric Power Service Corporation, and Ross, B. A. Western Coal Transportation - A Challenge. Washington, D.C.: American Mining Congress, 1974.

Mendelsohn, R. A., Sheppard, W. J., and Kimm, C. C. Analysis of Inland Waterways Oil Transport Traffic Density Patterns. Columbus, Ohio: Battelle Columbus Laboratories, October, 1973.

Nicholas, C. J., and Bailey, W. A. Reducing Physical and Quality Losses of Whole Soybeans in Transportation and Handling. Washington, D.C.: Department of Agriculture, February, 1977.

Phillips, R., Sorenson, L. O., and Schruben, L. W. How Extending River Navigation into Kansas and Central Oklahoma Would Affect Transportation Costs of Fertilzers. An Analysis of Findings. Manhattan, Kansas: Kansas State University, Department of Agricultural Economics, September, 1974.

The Transportation of Energy Commodities for the Appalachian Region. Volume 1. Washington, D.C.: Ernst and Ernst; Appalachian Regional Commission. April, 1978.

Transportation Service to Meet the Growing Needs of Agriculture. A Preliminary Report of the Rural Transportation Task Force. United States Department of Agriculture, June 1979.

TRC Development, Inc. A Study of Export Shipments of Selected Agricultural Perishables. Springfield, Virginia: National Technical Information Service, March, 1974.

Utility Analysis of Coal Transportation Availability. Final Report. Cambridge, Massachusetts: Energy Resources Company, Inc., and Washington, D.C.: Department of Energy, September, 1976.

Water Carriers and Inland Waterways in Agricultural Transportation. United States Department of Agriculture, August, 1977.

Witten, J. M. and Desai, S. A. Water Transportation Requirements for Coal Movement in 1985. Cambridge, Massachusetts: Input-Output Computer Services, Inc., and Transportation Systems Center, December, 1978.

PORTS: GENERAL

Bird, James. Seaports and Seaport Terminals. London: Hutchinson & Company, 1971.

The Effect of Federal Standards on U.S. Public Port Development. Washington, D.C.: Maritime Administration, United States Department of Commerce, April, 1978.

Fisher, K. W., Fisher Maritime Transportation Counselors, Inc. A Conceptual Data Base for Port and Shipping Developments. New York, New York: Society of Naval Architects and Marine Engineers, 1977.

Haefner, L. E., Washington University, Olympia; Mitchell, J., Real Estate Research Corporation; Wuenscher, D., Real Estate Research Corporation. "Need for a Port Planning Methodology." Washington, D.C.: Transportation Research Record; Transportation Research Board, Record No. 620, 1976.

Massachusetts Institute of Technology. Criteria and Requirements for Port Development and Operations. Washington, D.C.: Maritime Administration, United States Department of Commerce, October, 1977.

Office of Port and Intermodal Development. Public Port Financing in the United States. Washington, D.C.: Maritime Administration, United States Department of Commerce, October, 1973.

Office of Port and Intermodal Development. United States Ports: Serving World Shipping and Trade. Washington, D.C.: Maritime Administration, United States Department of Commerce, October, 1973.

Olson, H. E., and Dietz, A. L., Department of the Army. Development of Techniques and Data Input for an Analytical System for Planning and Evaluation of Water Transportation Facilities. Fort Belvoir, Virginia: Department of the Army; Engineering Institute for Water Research, March, 1978.

Pollock, E. E. Market Research. Marketing Technique and Service to Port Users. London: International Cargo Handling Coordination Association.

Port Authority of New York and New Jersey. Economic Impact of the United States Port Industry: An Input-Output Analysis of Waterborne Transportation. Volume 1. Springfield, Virginia: National Technical Information Service, April, 1978.

Port Authority of New York and New Jersey. Economic Impact of the United States Port Industry: An Input-Output Analysis of Waterborne Transportation. Volume 2. Springfield, Virginia: National Technical Information Service, April, 1978.

Port Development in the United States. Washington, D.C.: National Academy of Sciences, 1976.

Schwimmer, J. J., and Amundsen, Paul A. Management of a Seaport. Prepared for Maritime Administration, United States Department of Commerce, December, 1973.